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A REVIEW OF DENTAL RESEARCH
IN CANADA

Report of the Working Group
to the
Medical Research Council, Health and Welfare Canada
and the
Faculties of Dentistry
in Canada

March 1986

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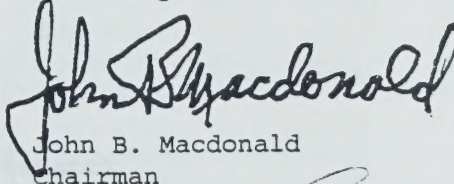
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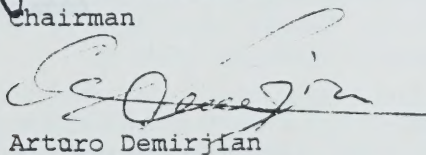
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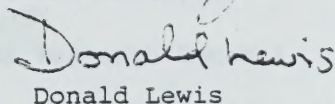
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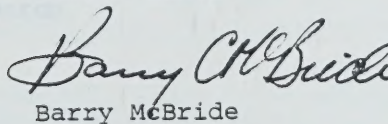
We have the honour of presenting our report on the status
of dental research in Canada.

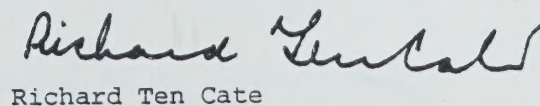
Sincerely,


John B. Macdonald
Chairman


Arturo Demirjian


Donald Lewis


Barry McBride


Richard Ten Cate

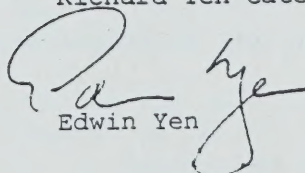

Edwin Yen

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INTRODUCTION

In November, 1984 the Medical Research Council and the Department of National Health and Welfare jointly established a Working Group to review the status of dental research in Canada and to make recommendations to Health and Welfare Canada, the Medical Research Council, and the Faculties of Dentistry concerning priorities, funding and organizational arrangements to sustain a viable program of dental research in Canada.

The members of the Working Group were John B. Macdonald (Chairman), Arto Demirjian, Donald Lewis, Barry McBride, Richard Ten Cate and Edwin Yen.

The Working Group met three times and members of the Group visited each of the ten dental schools in Canada. Meetings were held with the Dean and other officers of the Universities, faculty engaged in research and other members of the faculty who wished to comment on any matter related to the Group's terms of reference.

The Working Group assembled data on the history of dental research in Canada, the range of current dental research activities, sources and amounts of funding, kinds of awards available, dental research personnel, space, and training. In addition the Group reviewed the policies and procedures of the main granting agencies and the policies of the dental schools related to research. The quality and impact of Canadian dental research was assessed in fields where there has been some concentration of effort. Questionnaires were addressed to all full-time faculty in the schools as well as an open letter of invitation to all faculty to communicate their views and concerns by letter. A questionnaire was addressed also to 25 agencies and Foundations listed in the MRC's reference List of Health Sciences Research 1984-5. The twenty-five selected were those agencies thought to have mandates which might embrace dental research. The Natural Sciences and Engineering Council and the Social Sciences and Humanities Research Council also received the questionnaire. The enquiry sought information on the extent (if any) of the agencies' involvement in support of dental research. A further enquiry seeking data on personnel, research funding, space and students was addressed to each Dean.

The information and opinions gathered through these procedures are summarized in the following sections of this report. Strengths, deficiencies and problems are identified and solutions to current weaknesses are recommended.

The Working Group wishes to thank all those who responded generously and frankly to the Group's enquiries.

HISTORICAL DEVELOPMENT OF DENTAL RESEARCH IN CANADA

Although some dental research was conducted in dental schools in the years following World War I, dental research as an organized activity was launched in 1946 with the establishment by the National Research Council of an Associate Committee on Dental Research intended to: 1) stimulate research of interest to dental sciences among members of the dental profession and also in the basic and medical sciences; 2) coordinate dental research in Canada; 3) encourage close collaboration with other research organizations in problems of mutual interest; and 4) advance the application of research results in the interest of improved national dental health.* Eight applicants were supported in the first year by grants totalling \$13,650. Fellowship awards for dental graduates were introduced in 1949 and the first two awards were made in 1951.

The number and value of NRC awards increased gradually during the 22 year existence of the Associate Committee on Dental Research. By 1968, a total of 47 operating grants-in-aid and 32 fellowships were awarded for a total value of \$765,918.

Concurrently with the establishment of the NRC Associate Committee, the Canadian Dental Association began to offer studentships for graduates of dental schools to obtain graduate training to qualify them for research careers in basic sciences. The amounts available were modest. Over the 20 years of its existence the fund provided a total of 117 awards worth a total value of \$121,470 or an average of about \$1,000 per award. During its second decade the fund supported undergraduates as well as graduates. The very modest sums awarded nevertheless helped to make it possible for dental graduates interested in academic careers to obtain sound training and a number of studentship holders completed Ph.D.s in the United States and returned to academic appointments in Canadian dental schools.

A third development beginning in 1949 was the establishment of a subcommittee on dental research by the Department of National Health and Welfare. The object was to make awards for scientific activities consistent with the function of providing information needed by the department to fulfill its statutory responsibilities. The first nine awards were made in 1949 and totalled \$354,966. The number of awards has fluctuated over the years with a peak of 20 (1973-4) and a maximum value of \$400,843 (for 19 awards in 1972-3). The total value of the 9 awards granted in 1984-5 (the last year for which complete figures were available) was \$215,807.

In 1968, after considerable negotiation the mandate for support of dental research was transferred from the National Research Council to the Medical Research Council which had been established eight years earlier by a cabinet directive. Along with the transfer of responsibility a sum of \$790,000 was transferred from the National Research Council to the Medical Research Council (in 1969).

*National Research Council Review, 1946.

The Medical Research Council established a dental research committee to review applications while retaining the opportunity of referring applications to other committees where appropriate. Awards related to dental research remained in the neighborhood of a million dollars a year for the first four years of MRC sponsorship and then increased gradually to a total of \$4,000,992 in 1984-5 (Table 10).

It is relevant to note that the Medical Research Council itself is an offspring of the National Research Council. The origin of MRC was an NRC Associate Committee on Medical Research (established in 1938) and later expanded to become first the Division of Medical Research, then in 1960 the Medical Research Council. In 1964 the Report of the Royal Commission on Health Services recommended "that the Medical Research Council be broadened by appropriate legislation to include all fields of health research and renamed the Health Sciences Research Council." This recommendation was reiterated in a report to the Science Council on the Role of the Federal Government in Support of Research in Canadian Universities (1969).^{*} The broadening of mandate has certainly occurred but the name remains unchanged.

Organized dental research began at a time when there were five dental schools. Today there are ten. The expansion of dental education over the past thirty years has been accompanied by steady growth in research characterized best by an approximately five-fold increase in the number of dental researchers to a current total of about 140 (Table 1). The number of faculty with Ph.D. qualifications (with or without a dental degree) by 1984-5 was 86, while total full-time faculty numbered 382 (Table 3). Operating grants, a mere \$57,000 in 1954, increased to \$7,527,000 in 1984. Support from NRC and later MRC, the most important source of operating grants, grew from just under \$30,000 in 1954 to \$1,996,000 in 1984. In the latter year total research funding from MRC directed to dental schools for all types of awards, including personnel awards, amounted to \$4,000,992 (Table 10).

Space designated for research purposes was only 7300 sq. ft. in 1954, most of it located at the University of Toronto. The space assigned for research grew steadily to 106,000 sq. ft. in 1984 (Table 1).

All of the above indices provide clear evidence that research in the faculties of dentistry has grown from a position of novelty thirty years ago to the point where today it is an accepted part of any good program of dental education. These global measures of progress are encouraging and they are reinforced by the results of the Working Group's assessment of the quality and significance of Canadian dental research (see Section 4). Taken alone they could lead to unjustified complacency. While the number of funded researchers has grown to about 100 it must be noted that almost three quarters of the 382 full-time faculty are not engaged in funded research. Moreover funded investigators appear to be concentrated in the basic science disciplines and the faculty not involved in research are concentrated in the clinical departments as illustrated in the following section. Also an examination of the distribution of research

^{*}Macdonald, J.B., et al. Special Study No. 7, The Science Council of Canada and the Canada Council.

among the dental schools (next section) illustrates startling and discouraging differences. In short, in spite of the growth of dental research serious problems remain to be addressed.

TABLE 1
GROWTH OF DENTAL RESEARCH IN CANADA
1954-1984*

	<u>1954</u>	<u>1959</u>	<u>1964</u>	<u>1970</u>	<u>1984</u>
Total faculty engaged in research	30	28	57	105	140**
Faculty holding basic science degree and no dental degree	9	4	10	14	50***
Graduate students (including specialty training)	7	21	34	44	81
Operating grants					
NRC & MRC	\$29,645	\$76,555	\$194,400	\$744,000	\$1,995,890
Total, all sources	\$56,870	?	\$347,400	\$1,104,245	\$7,526,833
Space for research sq. ft.	7,300	30,000	39,850	61,390	106,000

*Data taken from surveys of dental research conducted by the Council on Dental Research of the Canadian Dental Association and published in Transactions, CDA 1955, 1959, 1964, 1970. The column for 1984 represents data submitted by the Deans of Dentistry. The figures are not strictly comparable from year to year because of differences in definitions and methods of collecting data.

**Responses to questionnaires. Faculty who held or applied for an award (any source) in 1984-5.

***Ph.D.s only. Masters degrees not counted. An additional 36 persons held both Ph.D. and D.D.S. or equivalent.

CURRENT RESEARCH ACTIVITY

The Working Group's best estimate of the number of awards for operating grants held by faculty members in dental schools was obtained from a questionnaire addressed to faculty members. Responses totalled 140 and 92 individuals indicated they held awards in 1984-5 (Table 2). The figure is no doubt incomplete. Some persons with awards will have failed to respond. The total value of awards reported, however, exceeded the presumably accurate total reported by the Deans. Even allowing for double counting this suggests that a very high proportion of award holders responded to the questionnaire.

The 1984-5 register of dental faculty in Canada shows a total of 382 fulltime appointees.* Two hundred and seventy-seven of them held their appointments in clinical departments and 105 in basic science disciplines.** Closer examination shows that 152 or 55% of the clinical appointees held qualifications which included Master's level or Ph.D. level training but only 17 or 6% held Ph.D.s. In the case of basic science appointees 94 or 87% held academic qualifications at the Masters or Ph.D. level. Sixty-nine or 65% held Ph.D.s. (Table 3).

The doctorate is the conventional academic qualification for persons planning an academic career. The Master's degree generally provides for initial supervised research experience but is unlikely to qualify individuals to compete successfully for peer-reviewed awards without further experience. Based on Table 4 it is apparent that the award holders are heavily skewed in favour of faculty with Ph.D. qualifications. About two-thirds of faculty with Ph.D.s were MRC grant holders in 1979; less than 10% of faculty without Ph.D.s held grants. This implies skewing in favour of basic science research rather than clinical research.

Such skewing is consistent with a misconception heard by the Working Group during visits to the dental schools that not only is there very little clinical research conducted but that applications for the support of clinical investigations do not fare well at MRC. This issue is considered in a later section.

Dealing with MRC applications and awards only, the Working Group was able to confirm the fact that there are indeed far fewer applications for clinical research than for basic science research (Table 5). This finding appears to be consistent with the distribution of research training between the clinical and basic science fields.

Faculty members responded to a question concerning the time available for research. The results are shown in Table 6. The respondees, as noted above, included most faculty engaged in research (one third of all full-time faculty). Relatively few faculty among those not engaged in research responded. The time available for research activity averaged about 18 hours a week though the range was broad. These estimates

*Canadian Dental Faculty and Staff Register 1984-5. The Association of Canadian Faculties of Dentistry.

**Oral medicine was counted as clinical; oral biology as basic science.

are consistent with policy reported by most schools which claim to allocate two days per week for scholarly activity. Despite such policy, complaints were heard during our visits that many clinical teachers have teaching and administrative loads that make research activity difficult or impossible.

The distribution by school of operating grants from all sources is shown in Table 7. It is clear that the national effort is heavily concentrated in half the schools, these schools accounting for 84% of the total operating grant support.

The source of awards is shown in Table 8 for 1984-5. MRC is by far the most important source of funds. Of the 129 awards listed 48 were received from MRC. Twenty-two awards came from provincial agencies (which exist in each province with a dental school, except Nova Scotia). Foundations made 20 awards, commercial firms 19, and universities 11. Other national sources and the National Institutes of Health (U.S.A.) accounted for the remainder.

The Foundations and philanthropic organizations supporting dental research are listed in Table 9. These represent a small fraction of the hundreds of Foundations listed in the Canadian Directory to Foundations and Granting Agencies whose subject interest falls in categories such as cancer, crippled children, dentistry, gerontology, health research, medical research, native peoples, public health, etc.* The Working Group draws attention to this Directory and advises researchers with special interests to consult the Directory for possible new sources of funding.

Awards to dental schools from MRC over the period 1980-1 to 1984-5 are shown in Table 10. The breakdown of the category listed as Institutional Grants is shown in Table 11. The following tables (12 - 21) show the distribution by type of award to each of the schools. These tables reinforce for MRC awards, the observation that research activities are heavily concentrated. The same schools appear at the top of the list as in the award totals from all sources.

Table 22 summarizes training awards from MRC for the years 1980-1 to 1984-5. The most striking feature of this Table is the complete absence of graduate student awards to dental schools for the entire five years. The inability to attract good science students to the dental schools probably reflects first the fact that except for oral biology the basic science teaching is attached to medical schools, and second the lack of knowledge among science graduates about the opportunities in oral biology. The result, in any case, is that the dental schools must recruit externally when seeking Ph.D.s (without dental qualifications) to join their faculties.

Funding from National Health and Welfare (the National Health Research and Development Program) is shown in Table 23. The amounts are very small, and have been shrinking for the past four years.

*Canadian Directory to Foundations and Granting Agencies. Fifth Ed. 1982. Volume 1, Foundations. The Canadian Centre for Philanthropy, 185 Bay Street, Toronto, Ontario M5J 1K6

Table 24 summarizes awards from a number of provincial agencies with mandates which include the field of dentistry.

Table 25 illustrates rates of success of grant applications to MRC, comparing dental applications to total applications.

The funding of dental programs by the National Health Research and Development Program is compared to total funding by NHRDP in Table 26.

Space allocated for research purposes is shown for each of the schools in Table 27. For most of the schools shortage of space is not a problem. Indeed in one instance (Dalhousie) the space available is sufficient to house a much larger program than presently exists. Four schools reported small allocations of space, but in two of these (Saskatchewan and McGill) the small area was not perceived to be a primary obstacle. In the case of the University of British Columbia however, a strong research program is being conducted in exceedingly crowded conditions. The crowding is so severe that in the view of the Working Group productivity must be affected. Further development of research would certainly require allocation of additional space. The University of Western Ontario also reports crowding although its research program is small. A large proportion of the available space is used for dental materials research and housing of specialized heavy equipment. If an expansion of research personnel is accomplished, space will become a limiting factor.

TABLE 2

**APPLICATIONS FROM AND AWARDS HELD BY FACULTY
OF CANADIAN DENTAL SCHOOLS, 1984-5, LISTED BY SCHOOL:
RESPONSES TO A QUESTIONNAIRE**

	n*	Applicants	Awards Holder**
University of Toronto	58	29	27
University of British Columbia	18	15	15
University of Manitoba	14	12	13
Laval University	11	7	6
University of Western Ontario	11	8	10
McGill University	8	7	7
University of Alberta	7	6	4
University of Saskatchewan	6	5	5
University of Montreal	5	4	3
Dalhousie University	2	0	2
TOTAL	140	93	92

*n = number of responses

**The numbers represent individuals. In many instances individuals listed held more than one award, often several awards.

TABLE 3
FULL-TIME FACULTY, CANADIAN DENTAL SCHOOLS
1984-5*

	Clinical Appointees			Basic Science Appointees		
	<u>Total</u>	<u>M.Sc.level</u>	<u>Ph.D.**</u>	<u>Total</u>	<u>M.Sc.level</u>	<u>Ph.D.**</u>
University of Alberta	29	14	4	13	3	10
University of British Columbia	26	10	3	10	4	6
Dalhousie University	40	12	1	8	3	4
Laval University	26	15	0	7	3	1
University of Manitoba	29	6	3	18	1	14
McGill University	16	10	1	5	1	3
University of Montreal	33	21	1	12	4	8
University of Saskatchewan	19	10	1	4	2	2
University of Toronto	37	24	2	18	3	13
University of Western Ontario	22	13	1	10	1	8
Totals	277	135	17	105	25	69

*Canadian Dental Faculty and Staff Register, 1984-5.

**Or equivalent.

TABLE 4

**NUMBER AND PERCENT OF FULL-TIME DENTAL SCHOOL STAFF
HOLDING A RESEARCH GRANT FROM MRC ACCORDING TO DEGREE OF GRANTEE***

<u>Year</u>	<u>D.D.S. Grantees</u>		<u>Ph.D. Grantees</u>	
	<u>Number</u>	<u>% F.T. D.D.S. Staff</u>	<u>Number</u>	<u>% F.T. Ph.D. Staff</u>
1970	31	14.2%	14	63.6%
1975	26	10.4%	18	58.1%
1979	26	9.2%	24	64.9%

*Source: Report of MRC Committee on Clinician-Scientists in Canada, 1981.

TABLE 5

RELATIVE SUCCESS RATES FOR DENTAL CLINICAL
GRANT APPLICATIONS TO MRC, 1980-85

	<u>Total Dental Applications</u>	<u>Clinical Applications*</u>
Number of applications	191	29
Number approved	80	11
% approved	42%	38%

*Studies related to clinical diagnosis and/or treatment involving patient management.

TABLE 6

HOURS/WEEK AVAILABLE FOR RESEARCH REPORTED BY
FACULTY OF CANADIAN DENTAL SCHOOLS, 1985:
RESPONSES TO A QUESTIONNAIRE

	Hours/Week			
	<u>n*</u>	<u>Range</u>	<u>Mean</u>	<u>Median</u>
University of Toronto	37	0-60	19	19
University of British Columbia	18	2-30	12	12
University of Manitoba	14	2-34	16	13
University of Western Ontario	11	1-40	17	16
Laval University	10	2-40	21	25.5
University of Alberta	9	5.5-24	17	18
McGill University	8	3-30	18	20
University of Saskatchewan	6	8-30	18	16
University of Montreal	5	30-40	36	40
Dalhousie University	2	18-20	19	19

*n = Number of responses. Most of those responding were funded researchers in 1985

TABLE 7

THE DISTRIBUTION OF OPERATING GRANTS
FOR RESEARCH FROM ALL SOURCES
CANADIAN FACULTIES OF DENTISTRY 1984-5*
(IN DESCENDING ORDER)

University of Toronto	2,430,256
University of Alberta	1,570,000
University of British Columbia	1,018,512
University of Manitoba	805,000
Laval University	474,658
University of Montreal	421,324
University of Western Ontario	325,000
McGill University	318,000
University of Saskatchewan	110,500
Dalhousie University	53,583

*Data supplied by Deans, Faculties of Dentistry

TABLE 8

**APPLICATIONS FROM AND AWARDS HELD BY FACULTY OF
CANADIAN DENTAL SCHOOLS, 1984-5, LISTED BY AGENCIES***

	<u>Number of Applications</u>	<u>Awards Held</u>
Medical Research Council	20	48
National Science & Engineering Research Council	4	6
Canada Department of Defence	1	1
Health & Welfare Canada	4	5
National Institute of Health, USA		1
Foundations & Philanthropic Organizations	28	20
Commercial Firms	19	19
Universities	13	11
Provincial Agencies		
B.C. Medical Services Foundation	3	2
B.C. Health Care Research Foundation	8	4
Alberta Heritage Foundation for Medical Research	3	3
Saskatchewan Health Research Board	1	3
Manitoba Health Research Board	4	3
Manitoba Research Council	1	1
Ontario Ministry of Health	6	5
Fonds de Recherche en Sante du Quebec	7	1

*Responses to questionnaire addressed to individual Members of Faculty.

TABLE 9

FOUNDATIONS AND PHILANTHROPIC ORGANIZATIONS FROM WHICH
AWARDS WERE HELD BY FACULTY OF CANADIAN DENTAL SCHOOLS 1984-5*

Bickell Foundation
Canadian Cystic Fibrosis Foundation
Children's Hospital (Winnipeg)
Connaught Fund (Toronto)
Fonds Emile Beaulieu
Heart and Stroke Foundation
Leprosy Relief of Canada
Local Cancer Society (Montreal)
Manitoba Heart Foundation
Mount Sinai Hospital (Toronto)
Ontario Heart Foundation
Physicians' Services Inc. Foundation
Vancouver Foundation

*Responses to questionnaire addressed to individual faculty members.

FUNDING PROVIDED TO CANADIAN DENTAL SCHOOLS BY THE MEDICAL RESEARCH COUNCIL
OF CANADA FROM 1980-81 TO 1984-85 BY RESEARCH CATEGORY AND BY DENTAL SCHOOL*

TABLE 10

Category	1980-81	1981-82	1982-83	1983-84	1984-85	Total 1980-85
Operating grants	965,493	1,033,453	1,338,223	1,877,328	1,995,890	7,210,387
Maintenance grants	24,080	29,276	32,936	38,510	37,492	162,294
Major equipment grants	-	115,303	-	165,110	117,020	397,433
Personnel (training)	249,875	386,434	481,109	394,387	463,799	1,975,601
Institutional grants**	993,369	1,267,200	1,300,077	1,525,515	1,386,791	6,472,952
Total	2,232,817	2,831,663	3,152,345	4,000,850	4,000,992	16,218,667
Dental School						
Dalhousie	37,030	46,846	72,559	87,218	75,878	319,531
Laval	45,500	182,825	165,106	225,447	269,741	888,619
McGill	18,359	36,724	81,344	87,961	57,607	281,995
Montreal	29,116	39,168	43,690	46,659	284,887	443,520
Toronto	1,139,953	1,366,628	1,547,344	2,051,282	1,912,825	8,018,032
Western Ontario	30,517	28,545	30,041	42,479	56,131	187,713
Manitoba	341,059	479,215	487,879	547,613	557,519	2,413,285
Saskatchewan	15,031	20,887	20,760	71,750	70,566	198,994
Alberta	232,981	248,454	195,997	217,060	164,869	1,059,361
U.B.C.	343,271	382,371	507,625	623,381	550,969	2,407,617
Total	2,232,817	2,831,663	3,152,345	4,000,850	4,000,992	16,218,667

*Dental research and training independently pursued in medical schools or teaching hospitals, i.e. outside dental schools, is not included.

**This category includes: MRC Group; scholarships (invest. salary); career investigators (invest. salary); Development grants (operating, major equipment, investigator's salary); General Research grants; President's fund; Visiting Scientists; Visiting Professorships.

TABLE 11

BREAKDOWN OF FUNDING PROVIDED BY MEDICAL RESEARCH COUNCIL IN ITS INSTITUTIONAL
GRANT CATEGORY TO CANADIAN DENTAL SCHOOLS 1980-81 to 1984-85

	<u>1980-81</u>	<u>1981-82</u>	<u>1982-83</u>	<u>1983-84</u>	<u>1984-85</u>	<u>Total 1980-85</u>
Scholarships						
Investigator's salary	83,035 (4)*	29,926 (2)	-	-	26,971 (1)	139,932
Research allowance	-				10,000 (1)	10,000
Visiting professorships	4,587	7,456	7,349	13,707	13,358	46,457
Visiting scientists	-	969 (1)	27,244 (1)	18,015 (3)	12,537 (3)	58,765
Career investigators (salary)	93,120 (2)	101,875 (2)	115,987 (2)	125,434 (2)	74,760 (2)	511,176
General research grants	100,000 (10)	150,000 (10)	150,000 (10)	250,000 (10)	150,000 (10)	800,000
President's fund (res. promotion/oper. grant)	-	-	17,200 (1)	18,580 (2)	5,000 (1)	40,780
Developmental grants						
operating grants	105,100 (2)*	154,782 (3)	36,750 (1)	37,100 (1)	85,717 (2)	419,449
investigators' salaries	9,940 (1)	29,700 (1)	44,578 (1)	48,347 (1)	73,322 (2)	205,887
major equipment	-	-	-	-	53,558 (1)	53,558
(sub-total)	(115,040)	(184,482)	(81,328)	(85,447)	(212,597)	(678,894)
MRC Group						
operating grant	471,320 (1)	642,516 (1)	723,805 (1)	730,246 (1)	679,565 (1)	3,247,452
investigators' salaries	126,215 (4)	149,976 (4)	177,164 (4)	192,567 (4)	202,003 (4)	847,925
major equipment	-	-	-	91,519	-	91,519
Institutional Grants Total	993,369*	1,267,200	1,300,077	1,525,515	1,386,791	6,472,952**

* Figures in parentheses refer, in the case of operating grants, to the number of grants held, and in the case of trainees and salaries, to the number of individuals receiving salary support.

** 1980-81 total includes \$52.00 travel grant to a research trainee.

Funding provided by the Medical Research Council of Canada from 1980-81 to 1984-85 to the dental school at the University of Alberta*

TABLE 12

Category & MRC program	1980-81	1981-82	1982-83	1983-84	1984-85
(a) Operating grants	122,595(6)	116,978(4)	78,029(2)	86,210(2)	89,445(2)
(b) Maintenance grants	19,803(1)	24,500(1)	27,440(1)	27,440(1)	26,250(1)
(c) Major equipment grants	---	---	---	---	---
(d) Personnel (training)					
Fellowships	41,842(3)	62,863(3)	59,874(2)	60,683(2)	17,713
Summer Undergraduate Research Scholarships	10,000(5)	12,750(5)	14,400(5)	15,000(5)	15,750(5)
Sub-total	51,842	75,613	74,274	75,683	33,463
(e) Institutional grants					
Scholarships (invest. salary)	28,741(1)	15,785(1)	---	---	---
General Research Grants	10,000	15,000	15,000	25,000	15,000
Visiting Professorships	---	578	1,254	2,727	711
Sub-total	38,741	31,363	16,254	27,727	15,711
(f) Total	232,981	248,454	195,997	217,060	164,869

*Figures in parentheses refer, in the case of operating grants, to the number of grants held, and in the case of trainees and salaries, to the number of individuals receiving salary support.

Funding provided by the Medical Research Council of Canada from 1980-81 to 1984-85 to the dental school at
the University of British Columbia*

TABLE 13

Category & MRC program	1980-81	1981-82	1982-83	1983-84	1984-85
(a) Operating grants	200,370(5)	220,280(5)	356,222(6)	396,524(6)	409,332(6)
(b) Maintenance grants	4,277(1)	4,776(1)	5,496(1)	11,070(1)	11,242(1)
(c) Major equipment grants	---	16,156(1)	---	100,110(3)	27,800(1)
(d) Personnel (training)					
Fellowships	---	---	22,000(1)	7,000	---
Summer Undergraduate Research Scholarships	8,000(4)	10,200(4)	20,790(6)	12,000(4)	22,680(6)
Sub-total	8,000	10,200	42,790	19,000	22,680
(e) Institutional grants					
Scholarships (invest. salary)	13,668(1)	---	---	---	---
Career Investigators (invest. salary)	49,882(1)	52,627(1)	59,260(1)	64,413(1)	59,033(1)
Development Grants (operating grant)	56,100(1)	62,832(1)	---	---	---
General Research Grants	10,000	15,000	15,000	25,000	15,000
Visiting Scientists	---	---	27,244(1)	5,504(1)	4,632(1)
Visiting Professorships	974	500	1,613	1,760	1,250
Sub-total	130,624	130,959	103,117	96,677	79,915
(f) Total	343,271	382,371	507,625	623,381	550,969

*Figures in parentheses refer, in the case of operating grants, to the number of grants held, and in the case of trainees and salaries, to the number of individuals receiving salary support.

Funding provided by the Medical Research Council of Canada from 1980-81 to 1984-85 to the dental school at Dalhousie University*

TABLE 14

Category & MRC program	1980-81	1981-82	1982-83	1983-84	1984-85
(a) Operating grants	20,500(1)	22,960(1)	47,900(2)	50,535(2)	50,535(2)
(b) Maintenance grants	---	---	---	---	---
(c) Major equipment grants	---	---	---	---	---
(d) Personnel (training)					
Summer Undergraduate Research Scholarships	6,000(3)	7,650(3)	8,640(3)	9,000(3)	9,450(3)
(e) Institutional grants					
General Research Grants	10,000	15,000	15,000	25,000	15,000
Visiting Professorships	530	1,236	1,019	2,683	893
Sub-total	10,530	16,236	16,019	27,683	15,893
(f) Total	37,030	46,846	72,559	87,218	75,878

* Figures in parentheses refer, in the case of operating grants, to the number of grants held, and in the case of trainees and salaries, to the number of individuals receiving salary support.

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Funding provided by the Medical Research Council of Canada from 1980-81 to 1984-85 to the dental school at
Laval University*

TABLE 15

Category & MRC program	1980-81	1981-82	1982-83	1983-84	1984-85
(a) Operating grants	31,500(1)	76,775(3)	61,005(2)	105,200(2)	181,205(4)
(b) Maintenance grants	---	---	---	---	---
(c) Major equipment grants	---	---	---	---	---
(d) Personnel (training)					
Studentships	---	---	2,013	---	---
Summer Undergraduate Research Scholarships	4,000(2)	5,100(2)	5,760(2)	9,000(3)	9,450(3)
Sub-total	4,000	5,100	7,773	9,000	9,450
(e) Institutional grants					
Development Grants					
Operating grant	---	56,250(1)	36,750(1)	37,100(1)	9,275(1)
Investigator's salary	---	29,700(1)	44,578(1)	48,347(1)	50,889(1)
General Research Grants	10,000	15,000	15,000	25,000	15,000
Visiting Professorships	---	---	---	800	3,922
Sub-total	10,000	100,950	96,328	111,247	79,086
(f) Total	45,500	182,825	165,106	225,447	269,741

* Figures in parentheses refer, in the case of operating grants, to the number of grants held, and in the case of trainees and salaries, to the number of individuals receiving salary support.

TABLE 16

Category & MRC program	1980-81	1981-82	1982-83	1983-84	1984-85
(a) Operating grants	222,456(7)	244,877(6)	360,982(8)	397,081(10)	440,962(11)
(b) Maintenance grants	---	---	---	---	---
(c) Major equipment grants	---	77,573(1)	---	35,000(1)	61,375(2)
(d) Personnel (training)					
Fellowships	---	48,167(3)	45,308(1)	8,000	---
Summer Undergraduate Research Scholarships	6,000(3)	7,650(3)	8,640(3)	9,000(3)	15,750(5)
Sub-total	6,000	55,817	53,948	17,000	15,750
(e) Institutional grants					
Scholarships (invest. salary)	10,365(1)	---	---	---	---
Career Investigators (invest. salary)	43,238(1)	49,248(1)	56,727(1)	61,021(1)	15,727(1)
Development Grants (operating grant)	49,000(1)	35,700(1)	---	---	---
General Research Grants	10,000	15,000	15,000	25,000	15,000
Visiting Scientists	---	---	---	12,511(2)	7,905(1)
Visiting Professorships	---	1,000	1,222	---	800
Sub-total	112,603	100,948	72,949	98,532	39,432
(f) Total	341,059	479,215	487,879	547,613	557,519

* Figures in parentheses refer, in the case of operating grants, to the number of grants held, and in the case of trainees and salaries, to the number of individuals receiving salary support.

Funding provided by the Medical Research Council of Canada from 1980-81 to 1984-85 to the dental school at
McGill University*

TABLE 17

Category & MRC program	1980-81	1981-82	1982-83	1983-84	1984-85
(a) Operating grants	---	11,160(1)	37,624(2)	39,581(2)	28,795(2)
(b) Maintenance grants	---	---	---	---	---
(c) Major equipment grants	---	---	---	---	---
(d) Personnel (training)					
Summer Undergraduate Research Scholarships	8,000(4)	10,200(4)	11,520(4)	12,000(4)	12,600(4)
(e) Institutional grants					
General Research Grants	10,000	15,000	15,000	25,000	15,000
Visiting Professorships	359	364	---	800	1,212
President's Fund (operating grant)	---	---	17,200(1)	10,580(1)	---
Sub-total	10,359	15,364	32,200	36,380	16,212
(f) Total	18,359	36,724	81,344	87,961	57,607

* Figures in parenthesis refer, in the case of operating grants, to the number of grants held, and in the case of trainees and salaries, to the number of individuals receiving salary support.

TABLE 18

Category & MRC program	1980-81	1981-82	1982-83	1983-84	1984-85
(a) Operating grants	---	---	---	---	57,084(1)
(b) Maintenance grants	---	---	---	---	---
(c) Major equipment grants	---	---	---	---	---
(d) Personnel (training)					
Centennial Fellowships	---	---	---	---	38,794(1)
Summer Undergraduate Research Scholarships	18,000(9)	22,950(9)	27,090(9)	20,400(6)	20,160(6)
Sub-total	18,000	22,950	27,090	20,400	58,954
(e) Institutional grants					
Development Grants					
Operating grant	---	---	---	---	76,442(1)
Major equipment grant	---	---	---	---	53,558(1)
Investigator's salary	---	---	---	---	22,433(1)
General Research Grants	10,000	15,000	15,000	25,000	15,000
Visiting Professorships	1,116	1,218	1,600	1,259	1,416
Sub-total	11,116	16,218	16,600	26,259	168,849
(f) Total	29,116	39,168	43,690	46,659	284,887

* Figures in parentheses refer, in the case of operating grants, to the number of grants held, and in the case of trainees and salaries, to the number of individuals receiving salary support.

Funding provided by the Medical Research Council of Canada from 1980-81 to 1984-85 to the dental school at the University of Saskatchewan*

TABLE 19

Category & MRC program	1980-81	1981-82	1982-83	1983-84	1984-85
(a) Operating grants	---	---	---	28,950(1)	40,050(1)
(b) Maintenance grants	---	---	---	---	---
(c) Major equipment grants	---	---	---	---	---
(d) Personnel (training)					
Summer Undergraduate Research Scholarships	4,000(2)	5,100(2)	5,760(2)	9,000(3)	9,450(3)
(e) Institutional grants					
General Research Grants	10,000	15,000	15,000	25,000	15,000
Visiting Professorships	1,031	787	---	800	1,066
President's Fund (research promotion)	---	---	---	8,000	5,000
Sub-total	11,031	15,787	15,000	33,800	21,066
(f) Total	15,031	20,887	20,760	71,750	70,566

* Figures in parentheses refer, in the case of operating grants, to the number of grants held, and in the case of trainees and salaries, to the number of individuals receiving salary support.

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Category & MRC program	1980-81	1981-82	1982-83	1983-84	1984-85
(a) Operating grants					
Operating Grants	368,072(10)	340,423(10)	396,461(9)	315,227(7)	321,003(8)
Program Grants	---	---	---	458,020(1)	377,479(1)
Sub-total	368,072	340,423	396,461	773,247	698,482
(b) Maintenance grants	---	---	---	---	---
(c) Major equipment grants	---	21,574(1)	---	30,000(1)	27,865(1)
(d) Personnel (training)					
Fellowships	30,400(2)	63,109(4)	129,274(5)	120,471(5)	125,488(6)
Dental Training Grant (Fellowships)	77,633(5)	84,792(4)	68,200(3)	57,833(2)	91,983(4)
Summer Undergraduate Research Scholarships	26,000(13)	33,150(13)	37,440(13)	30,000(10)	34,650(11)
Sub-total	134,033	181,051	234,914	208,304	252,121
(e) Institutional grants					
MRC Groups					
Operating grant	471,320(1)	642,516(1)	723,805(1)	730,246(1)	679,565(1)
Major equipment grant	---	---	---	91,519	---
Investigators' salaries	126,215(4)	149,976(4)	177,164(4)	192,567(4)	202,003(4)
Scholarships					
Investigator's salary	30,261(1)	16,141(1)	---	---	26,971(1)
Research allowance	---	---	---	---	10,000
General Research Grants	10,000	15,000	15,000	25,000	15,000
Visiting Scientists	---	969(1)	---	---	---
Visiting Professorships	---	978	---	399	838
Travel Grants to Research Trainees	52	---	---	---	---
Sub-total	637,848	823,580	915,969	1,039,731	934,377
(f) Total	1,139,953	1,366,628	1,547,344	2,051,282	1,912,825

*Figures in parentheses refer, in the case of operating grants, to the number of grants held, and in the case of trainees and salaries, to the number of individuals receiving salary support.

Funding provided by the Medical Research Council of Canada from 1980-81 to 1984-85 to the dental school at
the University of Western Ontario*

Category & MRC program	1980-81	1981-82	1982-83	1983-84	1984-85
(a) Operating grants	---	---	---	---	---
(b) Maintenance grants	---	---	---	---	---
(c) Major equipment grants	---	---	---	---	---
(d) Personnel (training)					
Centennial Fellowships	---	---	---	---	24,131(1)
Summer Undergraduate Research Scholarships	10,000(5)	12,750(5)	14,400(5)	15,000(3)	15,750(5)
Sub-total	10,000	12,750	14,400	15,000	39,881
(e) Institutional grants					
Development Grants (invest. salary)	9,940(1)	---	---	---	---
General Research Grants	10,000	15,000	15,000	25,000	15,000
Visiting Professorships	577	795	641	2,479	1,250
Sub-total	20,517	15,795	15,641	27,479	16,250
(f) Total	30,517	28,545	30,041	42,479	56,131

* Figures in parentheses refer, in the case of operating grants, to the number of grants held, and in the case of trainees and salaries, to the number of individuals receiving salary support.

NUMBER OF INDIVIDUALS RECEIVING TRAINING AWARDS FROM THE
MEDICAL RESEARCH COUNCIL OF CANADA, 1980-81 TO 1984-85

Year	Summer Students (undergraduates)			Graduate Students		Research Fellows (post-Ph.D. & post-professional)		
	Total No. all Faculties	Total No. Dental Schools	Total No. all Faculties	Total No. all Faculties	Total No. Dental Schools	Total No. all Faculties	Total No. Dental Schools	Total No. Dental Schools
1980-81	189	50	242	-	-	318	10	
1981-82	187	50	277	-	-	330	14	
1982-83	189	52	296	-	-	342	12	
1983-84	180	44	309	-	-	343	9	
1984-85	277	51	343	-	-	356	12	

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DENTAL RESEARCH FUNDING PROVIDED BY THE NATIONAL HEALTH RESEARCH AND DEVELOPMENT
PROGRAM FROM 1980-81 TO 1984-85 BY RESEARCH CATEGORY AND BY DENTAL SCHOOL

Category*	1980-81	1981-82	1982-83	1983-84	1984-85	Total 1980-85
Operating grants	277,372	331,968	268,261	175,319	174,477	1,227,397
Personnel (training)	11,062	770	-	35,900	38,630	86,362
Conference support	-	6,522	27,589	14,119	2,700	50,930
Total	288,434	339,260	295,850	225,338	215,807	1,364,689
Dental School**						
Dalhousie	-	-	-	5,000	-	5,000
Laval	37,264	-	14,675	20,300	40,982	113,221
McGill	-	-	-	8,855	39,829	48,684
Western Ontario	-	82,400	32,076	3,338	-	117,814
Toronto	-	15,000	-	11,262	27,066	53,328
Manitoba	-	-	13,569	4,415	-	17,984
U.B.C.	-	-	5,792	644	-	6,436
Subtotal	37,264	97,400	66,112	53,814	107,877	362,467
Growth Center (U. Montreal)	196,363	198,740	194,056	124,245	66,600	780,004
Other Agencies	54,807	43,120	35,682	47,279	41,330	222,218
Total	288,434	339,260	295,850	225,338	215,807	1,364,689

* NHRDP does not award maintenance, major equipment or institutional grants.

** No grants listed during this period for Montreal, Saskatchewan or Alberta dental schools.

DENTAL RESEARCH FUNDING REPORTED BY PROVINCIAL AGENCY RESPONDENTS IN RECENT FIVE-YEAR PERIOD

TABLE 24

Provincial Agency	Grant Category	Amount Funded and (Number) of Awards Per Year						Total
		Year:	1981-82	1982-83	1983-84	1984-85	1985-86	
Fonds de la Recherche en Sante du Quebec	operating personnel		40,000 15,000	41,000 15,000	45,000 15,000	45,000 -	50,000 -	1981-86 221,000 45,000
Ontario Ministry of Health*	operating personnel	Year:	1980-81 388,317 (11) 47,372 (1)	1981-82 331,350 (15) 52,944 (2)	1982-83 205,338 (9) 29,365 (3)	1983-84 192,617 (7) 88,492 (3)	1984-85 26,372 (2) 95,474 (3)	1980-85 1,143,994 (44) 313,647 (13)
Manitoba Health Res. Council	operating	Year:	1981 0	1982 35,480 (2)	1983 0	1984 32,000 (1)	1985 34,000 (1)	1981-85 101,480 (4)
Saskatchewan Health Res. Board**	operating	Year:	1981-82 0	1982-83 66,997 (2)	1983-84 99,659 (2)	1984-85 0	1985-86 0	1981-86 166,656 (4)
Alberta Heritage Foundation for Med. Res.	major equipment personnel - institutional	Year:	1981 42,914 39,970 (7) 27,214	1982 13,600 61,066 (7) 216,572	1983 78,673 107,450 (7) 47,415	1984 38,322*** 96,255 (9) 381,793	1985 9,855*** 94,572 (10) 78,415	1981-85 183,364 399,313 751,409
British Col. Health Care Res. Foundation	operating	Year:	1981 20,000 (1)	1982 76,000 (3)	1983 80,200 (4)	1984 63,000 (2)	1985 99,000 (3)	1981-85 338,200 (13)

* Decreased operating project support over time is due to cancellation of a grant program in favour of increased support for development of researchers.

** After 1983-84 emphasis has been placed on establishment grants for new researchers.

*** \$2,254 of this total in 1984 was for "maintenance" and the entire \$9,855 in 1985 was for this purpose.

TABLE 25

**SUCCESS RATES OF GRANT APPLICATIONS
TO MRC 1983-85**

	<u>Total Applications</u>			<u>Dental Applications</u>		
	<u>New</u>	<u>Renewal</u>	<u>Total</u>	<u>New</u>	<u>Renewal</u>	<u>Total</u>
Number of applications	2200	1191	3391	77	35	112
Number approved	699	929	1628	20	24	44
% approved	32%	78%	48%	26%	69%	39%

TABLE 26

TOTAL FUNDING OF THE

NATIONAL HEALTH RESEARCH AND DEVELOPMENT PROGRAM

COMPARED TO FUNDING OF DENTAL PROGRAMS 1980-85*

	Dental Funding			Total Funding
	Dental Schools	Other Agencies	Total	
1980-1	37,264	251,170	288,434	9,997,000
1981-2	97,400	241,861	339,260	11,150,165
1982-3	66,112	229,738	295,850	14,089,280
1983-4	53,814	171,525	255,338	16,043,335
1984-5	107,877	107,930	215,807	18,123,000
Five year total	362,467	1,002,224	1,364,691	69,402,780
% of total funding	0.5%	1.4%	2.0%	

*Source: Health and Welfare Canada

TABLE 27

RESEARCH SPACE IN CANADIAN
DENTAL SCHOOLS, 1984-85

	Research Space (square feet)	Square Feet/ \$1000 grant support
University of Alberta	12,234	7.8
University of British Columbia	4,650	4.6
Dalhousie University	15,000	280.4
Laval University	9,746	20.5
McGill University	3,250	10.2
University of Manitoba	15,000	18.6
University of Montreal	8,766	20.8
University of Saskatchewan	4,465	40.4
University of Toronto	27,711	11.4
University of Western Ontario	5,184	15.9

QUALITY OF DENTAL RESEARCH IN CANADA

The Working Group's approach to the assessment of quality was to ask a number of international experts to evaluate a preselected list of the best Canadian publications. The method is essentially subjective in both the choice of reviewers and in the opinions they expressed. Nevertheless, it provides an independent assessment of Canadian dental research as seen through the eyes of a group of highly respected scientists from other countries.

The papers chosen for review were drawn from publications in six fields in which there has been a significant level of research activity. The fields were neurophysiology, connective tissue biology, microbiology, growth and development, epidemiology and community health, and dental materials.

Each research area was assigned a chairman active in the field (Appendix I), who was given responsibility for coordinating the selection of the top 15 papers published in the field by Canadian dental scientists during the previous five years and three to five older papers of unusual significance. Chairmen were urged to seek the opinions of all active scientists with the appropriate research interests. The chairmen collated the results of this preliminary inquiry and prepared a ranked listing of the publications. Each listing was accompanied by a brief synopsis commenting on significance, impact and quality. Chairmen were also asked to identify international experts who would be suitable external referees.

The last step in the process involved placing the body of work in an international context. The coordinator of the assessment project* collected the publication lists from the six chairmen and submitted them to a number of non-Canadian based internationally recognized experts who could provide an unbiased, arms-length appraisal of the work (Appendix II). The external referees were asked to: (1) compare quality to work done in other countries; (2) indicate whether the work had led to new insights and created new directions in research.

The results of this assessment can be summarized most succinctly by the use of representative quotations from the reviewers' comments. This is made easy by the remarkable consistency of the reviewers' assessments and the fact that, except for one field, they were uniformly favourable. The body of work submitted for review represented the best of Canadian dental research in each of the areas examined as judged by the Canadian scientists who selected the publications. The international referees elevated the work to a position high, indeed in many instances at the very top, by international standards. In several instances reviewers noted that the work was of great importance beyond the field of dental research and shed light on fundamental biological problems.

As would be expected, given the high praise almost all the papers submitted were published in leading stringently refereed international

*Dr. Barry C. McBride

journals, many of them non-dental in orientation. The few exceptions related to work which had specific significance for Canada and in these cases the work was nevertheless known by the international community. A small number of papers were subjected to citation analysis which showed they have been cited in a wide range of dental and biomedical journals by scientists working in Europe, Japan, Israel, Great Britain and the United States.

A representative selection of quotations from the reviewers follows with names omitted.

Connective Tissue Biology

"In general the quality of research illustrated by the appended papers is high and compares favourably with laboratories in countries outside Canada."

"One of the most significant papers to appear in the area of collagen metabolism."

"One of the most significant papers to appear in the collagen literature, its impact has extended far beyond the dental literature. It is the most widely quoted paper on this subject."

"This work is one of the most important papers on osteonectin. This paper and related publications from this group are likely to have a significant impact on others studying bone protein."

"The paper represents one of the most significant articles to appear in the literature on periodontal connective tissue."

Dental Materials

"I would describe the 15 current publications as covering a quality range from average to above average. There are no monumental papers. Of the five older papers all are excellent and have high levels of significance."

"The paper is outstanding in significance and has led to improved dental restorative materials."

"My overall reaction is that eight papers rank with the "best" from other countries. Of the remainder five would be classified as good and seven as fair."

Epidemiology

"An excellent study which has been used as a guide for development of dental health care delivery in other countries."

"Major contribution to community dental care."

"Major contribution which highlighted and developed a new area."

Growth and Development

"I regard the work of Dr. --- as superb and on a par with the best anywhere in the world. The work of the others is generally first class. I have basic disagreements with some of Dr. --- work."

"In my opinion your group has selected a fine list of papers that are indeed significant. The quality of these papers would be scored as "very good" by any international evaluation process. Each of these papers identified and built upon important problem areas of dental research. It is evident that Canadian scientists continue to contribute to the quality of international biomedical research."

Microbiology

"The quality of the work as represented by these papers is outstanding. They represent solid contributions to the dental literature, but also, because of their concern for adhesion, metabolism and immunology are important in the microbiology literature."

"The group at Laval is one of the more exciting young groups operating perhaps in North America."

"Dr. --- successfully trained a new generation of oral bacteriologists who have themselves become highly regarded."

"When one considers how few in number the Canadian schools are relative to the U.S. and European schools, the contributions of the Canadian schools to Oral Microbiology are indeed impressive. They represent a group of researchers and teachers in whom the Canadian research establishment can be truly proud."

"This work paves new ways in the research on fluoride and oral ecology."

"This work was very important"

"This work is one of the cornerstones of modern oral microbiology."

Neurosciences

"There is little question that these publications are first rate. First they are published in the most

prestigious journals in the field. Second they present findings that are significant for the whole field of neuroscience and not merely for dental research."

"The papers referred to are recognized as important by workers in the field."

"The papers listed are in the mainstream of neuroscience research and their senior authors are recognized leaders in their field."

It is worth looking at the distribution of the researchers which shows that the investigators in these six dominant fields tend to be concentrated in relatively few institutions (Table 28.) The uneven distribution of dental research in Canada is illustrated further by the fact that the University of Toronto was identified as having strong to excellent programs in all of the six fields studied. The University of British Columbia was identified in five categories, University of Montreal in three categories. Three institutions were cited in two categories, two in one category, and one institution was not mentioned.

The conclusion which we draw from this assessment is that Canadian dental researchers, although few in number, are conducting studies of high quality in several fields and are making important contributions to dental and biomedical knowledge.

TABLE 28

DISTRIBUTION OF PAPERS REVIEWED FOR QUALITY ASSESSMENT

Discipline	Number of Papers	Number of Senior Investigators	Number of Universities Represented
Connective Tissue Biology	14	8	4
Dental Materials	20	8	4*
Epidemiology and Community Health	15	9	4*
Growth and Development	15	5	3
Microbiology	14	8	5
Neurophysiology	17	4	3

*Most papers drawn from only two universities.

POLICIES OF FUNDING AGENCIES

In this section, for the benefit of applicants and potential applicants in the dental schools the Working Group wishes to highlight policies and practices of the principal granting agencies which are relevant to the sponsorship of dental research and training for research. The bodies to which reference is made include MRC, the National Health Research and Development Program of the Department of Health and Welfare, the Natural Sciences and Engineering Research Council, and the National Institute of Dental Research in Bethesda Md. Readers are urged to consult also with provincial agencies making awards in the province where their dental school is located. A list of such provincial agencies is included in Table 8.

Medical Research Council

The Medical Research Council's function is to:

"(a) promote, assist and undertake basic, applied and clinical research in Canada in the health sciences; and

"(b) advise the Minister in respect of such matters relating to such research as the Minister may refer to Council for its consideration."

Its objectives are:

"To help attain the quality and scale of research in the health sciences essential to the maintenance and improvement of health services.

To support research contributing to new knowledge in the health sciences.

To ensure an adequate research base for education in the health sciences.

To improve the application of scientific principles to health care.

To expand the scientific and technological base for health care."

To be eligible for awards investigators normally must hold an academic appointment in a Canadian School of medicine, dentistry, nursing, optometry, or pharmacy although special consideration will be made for individuals in other faculties or institutions.

The complete range of MRC's awards is described in Appendix III. They include operating grants, major equipment grants, maintenance grants, group grants, program grants, clinical trials, development grants, subject research development grants and biotechnology development grants. Personnel programs include research trainee programs for undergraduate dental students, studentships, dental fellowships, individual investigators' salary support programs and programs for visiting

investigators.

Taken as a whole these programs offer a wide range of options for well-qualified investigators to gain support for their research interests tailored to their particular needs. In addition the variety of personnel programs offer the possibility of stipends or salary support from the undergraduate level through graduate and postdoctoral level. They include also the possibility of having the salary of a faculty member underwritten for several years. The more senior of these appointments are reserved for truly outstanding candidates but they offer to the schools a way of approaching development and adding strength to their faculty complements.

There are no programs designed exclusively for dental research activities with the exception of the Dental Fellowship for training of graduate students, but dental research applicants are eligible for all programs. Applicants for operating grants may wish to have their application reviewed by the Dental Sciences Committee or any other Committee that they feel would serve as a peer review group. The Dental Sciences Committee consists of eight internal reviewers from different research areas with some attention paid to geographic and subject representation. Special reviewers are now brought in for individual applications for which there are no internal reviewers of sufficient expertise. The Dental Sciences Committee places a score on each application using scientific merit and expertise of the applicant as the main criteria. Productivity, in the case of renewal applications, is also an important criterion. This score then competes with similarly scored applications from all of the other committees (e.g. Pathology, Clinical Investigation etc.). No special weighting is given to proposals from any particular committee and efforts are made to ensure that all committees score with comparable degrees of rigour. Because review committees include only persons who hold MRC grants, there is the possibility for some applications to be reviewed by individuals not familiar with the applicant's field of expertise. This is offset by the use of up to four external reviewers per application and the inclusion of a special reviewer on the internal committee as mentioned above. The feedback mechanism consists of sending the applicant copies of the verbatim reviews from each reviewer. However, the applicant usually is not informed of any factors that the review committee may have used in discussion and which may have a direct bearing on the outcome of the scoring.

National Health Research and Development Program

The function of the National Health Research and Development Program is to support scientific activities which can provide information needed by the Department of Health and Welfare to fulfill its statutory obligations. Five areas of priority have been identified:

1. Organization and Delivery of Health Care: Factors (e.g. demographic or geographic) which influence demand, availability, accessibility and quality of health care; models for more cost-effective care.
2. Environmental Health Hazards: Emphasis is on disease agents in drinking water, indoor environments and hazards from low frequency

radiation.

3. Primary and Secondary Illness Prevention: Identification of high risk populations; impact of existing health promotion programs; development and evaluation of preventive regimens including vaccines.
4. Habilitation and Rehabilitation: Development of innovative programs supportive of independent living.
5. Health of Native Peoples: Emphasis on studies of problems of an enduring and intractable nature; development of community-based strategies for improving health status.

Obviously three of these priorities (numbers 1, 3 and 5) include important problems for dental researchers, especially (but not only) for persons trained in epidemiology and public health.

The Natural Sciences and Engineering Research Council

The Natural Sciences and Engineering Council is a granting body to promote and assist research in the natural sciences and engineering other than the health sciences. Among its fields of interest those relevant to dentistry include biology, medicine, food services and kinesiology. Projects in any of these fields may overlap with the interests of the Medical Research Council. Applications therefore are reviewed to determine which agency is the appropriate one to deal with the proposal. Materials science studies in dentistry generally are handled by NSERC.

National Institute of Dental Research

This large granting agency uses a wide variety of mechanisms to support dental research. Two of them, namely individual project grants (ROI) and so-called "small grants" are available to Canadian researchers. These grants are comparable to MRC operating grants. The extramural program of NIDR has several branches dealing respectively with periodontal and soft tissues disease, craniofacial anomalies, pain control and behavioural studies, caries and restorative materials, epidemiology and oral disease prevention.

Both of the grants programs should be of particular interest to Canadian dental schools. The individual project grants can provide up to 50% of the salary of the principal investigator. This feature should be helpful to schools which are trying to develop new research capability. The "small grants" (up to \$15,000) represent an avenue which should not be overlooked for new researchers to get started quickly. The Working Group heard a number of complaints that it is difficult to get started in the absence of a "track record."

PROBLEMS AND RECOMMENDATIONS

The Distribution of Dental Research in Canadian Dental Schools

The most startling finding of this review is the extraordinary variation in research activity in different schools. Significant variation could be expected, of course, because of the different sizes and different ages of the schools. Half of the 10 schools were established during the past twenty-five years; and the 10 schools range in size from 408 undergraduates and 94 graduate students (Toronto) to 105 undergraduates and no graduate students (Saskatchewan). Surprisingly, however, the differences in research activity do not correlate with either of these variables. Two of the newer schools (UBC and Manitoba) are among the leaders in research; two of the old established schools (Dalhousie and McGill) are among the least active. Likewise, UBC and Manitoba, although strong research schools, are relatively small schools (undergraduate enrolments of 154 and 117 respectively); Western and Montreal, somewhat larger schools, with enrolments of 204 and 326 undergraduates, have limited research activity.

What accounts for the differences? The conclusion of the Working Group, based on interviews across the country, is that the differences reflect widely divergent philosophies of education. Schools with strong research programs have faculties who perceive their role to be transmission and generation of knowledge. Teaching and research are viewed as inseparable functions and good dental education is infused with both.

An alternative view has prevailed traditionally in dental schools as it has in many other professional schools. That is the view that the primary role of the school is to qualify students for contemporary practice of their profession. Whether the school teaches dentistry, law, pharmacy, or engineering the commitment to qualifying students for professional practice, historically, has dominated. This perspective has been reinforced in dentistry by the fact that the university's stamp of approval is accepted by the professional regulating bodies as qualification for licensure. It has also been reinforced by the fact that most teachers in dental schools are clinicians (72% of all full-time teachers; Table 3) and exhibit a preoccupation with clinical excellence which by sheer force of numbers can dominate the school's philosophy.

The nature of dental practice -- the execution of exacting techniques, can also focus attention on skills at the cost of a spirit of enquiry. The school can easily become satisfied with "doing it well" rather than questioning also whether it is the best thing to do.

Such preoccupations represent a trap for all professional schools and a recipe for stagnation. Leading schools tend to be agents of change, critics of conventional practice and exponents of reform and advancement. These attributes coincide with the expectations of the universities of which professional schools are a part. The professional schools which combine clinical excellence with genuine academic enquiry co-exist most comfortably with their parent universities, and they produce graduates not merely qualified for contemporary practice, but graduates more open to change and more prepared for an uncertain future.

The fundamental question therefore is whether a national objective for dental research should be to establish a strong research presence in every dental school. Since one of the principal reasons for doing research in a dental school is to enhance the quality of teaching the argument for such a policy may seem to be compelling. There are difficulties however.

Some of the schools have small full-time staff, limited prospects for renewal through retirements, and no prospects for expansion. Total numbers of full-time faculty for the smaller schools are:

McGill	21
Saskatchewan	23
Western	32

It will not be easy for these schools to develop substantial research and the question was raised by correspondents with the Working Group as to whether in these small schools a 'critical mass' of researchers sufficient to sustain a good cross-fertilizing intellectual environment is a realistic objective.

A second issue relates to the demand for dental education. The Working Group draws attention to important changes in the burden of dental illness. Caries prevalence rates among children have dropped startlingly in the past 10-20 years in developed countries. Reductions have ranged between 32% and 45%. The number of adolescents who are caries-free in various Canadian and United States surveys is close to 40%. Young adults too are showing reductions and these will almost certainly be larger as the cohorts of children reach adulthood.

Periodontal diseases may be increasing* but the need for therapeutic intervention, especially radical surgical intervention, is being challenged. Even the presence of low levels of plaque and calculus may be compatible with the absence of destructive periodontal disease through to old age.**

Offsetting these trends are demographic changes due to extending life expectancy and a growing proportion of the Canadian population over the age of 65. These changes, coupled with retention of dentitions, will create new demands for appropriate care for well, unwell and functionally dependent elderly populations.

The implications of these changes for dental education are currently a matter for both debate and policy decisions. The Royal College of Dental Surgeons in Ontario for example has been studying both supply and demand for dentists. The two schools in Ontario have recently reduced their enrolments. Suggestions were made to the Working Group that too many dentists are being produced and that there are too many schools in Canada.

It is beyond the scope of this study to predict the future need for dentists or to advise concerning the options facing dental education.

*1985 Canadian Armed Forces Survey

**Burt, B.A., et al. "Community Dentistry and Oral Epidemiology" 13: 93-6: 1985.

The Working Group accepts however that if good studies conclude that dental enrolments should shrink, the way in which such shrinkage should occur has a bearing on dental research. Canada's research strength in dentistry would be more productive if concentrated in fewer centers. Thus it is the judgement of the Working Group that if dental enrolments are to be reduced in Canada, it would be better from the standpoint of dental research to close schools rather than to reduce enrolments pro rata.

The Working Group however must face the prospect that for a variety of reasons, perhaps mostly political, all ten schools may continue to exist. The state of dental research in some of these schools is deplorable and steps are needed to remedy this situation, not least because of the consequences for dental education. From the standpoint of the granting bodies, especially MRC, we believe the best policy is to create appropriate opportunities available to all schools. We do not favour any kind of "affirmative action" aimed at upgrading weak programs. Such programs inevitably would compromise commitment to quality in the interest of "getting research started" and would be a recipe for failure. Poor research contributes nothing of value.

The range of awards currently available through MRC comes close to providing the opportunities needed. They include individual grants and group grants and a variety of personnel awards beginning at the undergraduate level and extending to salary support for outstanding qualified investigators. The arrangements for training however do not take account of the distribution of dental research resources and are unlikely to provide the trained personnel essential to broadening the base of research competency.

The present system relies on individual studentships or fellowships including the dental fellowship designed for persons seeking a combination of specialty training and a Ph.D. Unfortunately students in schools with token research are offered little incentive to obtain good academic qualifications. They are not exposed to appropriate role models. Success is measured in terms of clinical skills, and the prospects of a teaching career are not perceived to require research competence. Under these circumstances the hurdles to overcome in order to get started on an academic career path are formidable. The graduate must first be prepared to forego the immediate rewards of dental practice, second, gain acceptance into a suitable program and third, apply for and receive a fellowship. If a candidate has begun practice an added complication is the feasibility and timing of disposing of the practice. In the event that a candidate completes the above steps he is likely to be enrolled in a program in the United States where opportunities are more numerous and again because of the opportunities may ultimately end up in an academic post in an American school. Finally an arrangement based on individual fellowships means that there is no systematic approach to generating the required cadre of dental researchers in Canada.

To overcome these difficulties the Working Group proposes the re-establishment of a training grant program in Canada designed to meet the needs of the Canadian dental schools. It is our view that at the present time three schools have the capacity to offer opportunities of sufficient breadth and depth to warrant participation in a training program. These are Toronto, UBC, and Manitoba. We believe there would be advantages in a

single program, jointly sponsored and providing mobility for students in order to offer the best training possible. We believe it prudent however to leave the design and sponsorship to these and indeed other universities with the expectation that a proposal will be submitted to MRC which maximizes the utilization of the resources available.

The size of an ideal program should be sufficient to begin enlarging the proportion of research-trained faculty and to provide replacement of faculty lost through attrition. We propose that the numbers completing a training program annually should be based on the same estimate of demand as that used by MRC in its Discussion Paper Proposal for a Five-Year Plan (1983). These estimates assumed a growth rate in full-time positions of 2% and an attrition rate of 1.5%. Both these estimates were considered to be conservative (p.61 idem). Applying these numbers to the current roster of 382 full-time faculty yields a required annual output of 13.

The advantages of a training grant program would be that:

- a) The program(s) could be designed in toto to meet the Canadian demand and could be tailored to Canadian academic needs;
- b) The program(s) would be more likely than the present system to recruit promising students in Canada;
- c) The program(s) would minimize the hurdles for prospective candidates. A single application to the institution holding the grant would determine eligibility for enrolment and for funding;
- d) The existence of such a program in Canada would improve communication among the members of the dental research community.

The Working Group therefore recommends that:

- 1) **MRC entertain a proposal or proposals from Faculties of Dentistry for the establishment of a training grant or grants which in toto meet the anticipated Canadian demand for dental researchers, estimated at 13 persons annually.**

Coupled with the objective of a national training grant program is the problem of recruitment to such a program. One of the best ways of attracting candidates to careers in academic dentistry is to whet their appetite for research while they are undergraduates. The MRC summer studentships which give undergraduates an opportunity to work with qualified researchers is an important element in recruitment and could usefully be expanded -- especially as a method of motivating interest in subsequent candidacy for a national training program. The 50 or so studentships now available are distributed more or less uniformly among the 10 schools but if the numbers are increased it would be wise to select the best students through a national competition. The Working Group recommends that:

- 2) **The number of summer studentships available to dental schools be increased by 30 and that the additional 30 studentships be awarded through a national competition which takes account of the qualifications of both the student and his/her sponsor.**

The availability of fully-trained researchers is an absolute requirement for the development of dental research -- but availability is by no means sufficient to ensure development. The priorities of the schools need to change so that the importance of a research orientation is recognized and accepted. Leadership from the Deans is important, but leadership must be accompanied by willingness to be led. A number of steps can be taken by the schools to improve the climate for research and these are the subject of the following sections.

Budgetary Arrangements

In many of the dental schools basic science budgets are completely within the Faculties of Medicine although the basic science departments are responsible for teaching dental students. The result of the budgetary arrangements is that basic science teachers are selected on the basis of criteria important to the Faculty of Medicine. The priority for dental research is low or non-existent. If a reasonable share of the budget of basic science departments was derived from the dental school it would be possible to ensure that some basic science appointments reflected the interests of dentistry. This arrangement does not imply finding additional funds but simply reallocating the source of funds to reflect the responsibilities for dental education and dental research. The Working Group recommends that:

- 3a) **Some reasonable share of the funding of basic science departments be derived from the budget of the dental schools and the dental schools participate appropriately in the selection of basic science appointees.**

Where, for any reason, it proves to be impossible or impractical for a suitable new budgetary arrangement to be implemented the Working group recommends that:

- 3b) **Alternatively a written agreement be negotiated between the Faculty of Dentistry and the Faculty of Medicine spelling out the responsibility of basic science departments for the conduct of research relevant to dental problems.**

Research Seminars

A series of research seminars conducted for all faculty in the dental school and open to students would be a useful addition to the academic environment. It would expose basic science teachers and clinical teachers to each other and would identify problems relevant to dentistry. Over time it would help to create a more critical approach and stimulate interest in research opportunities.

Undergraduate Thesis Program

The introduction of an undergraduate thesis program (based on an analysis of literature) would improve the ability of students to approach their subject critically.

Summer Studentships

Greater use of summer studentships would introduce students to research under the guidance of qualified investigators and would expose the option of research careers at an appropriate stage in the students development.

The Working Group recommends that:

- 4) **All dental schools draw on the resources of clinicians and basic science teachers to introduce research seminars and undergraduate thesis programs and to expand the number of summer studentships, all as a means of stimulating interest in dental research and a more scholarly approach to dental education.**

Linkages

Many excellent clinicians with a critical approach to therapeutic procedures lack the training and expertise to design and carry out good research protocols. Advantage should be taken of the opportunity to form linkages between these faculty members and both basic science teachers and clinicians qualified and experienced in research design. As partners, such teams could bring a broader range of expertise to bear on important problems and could overcome the frustrations felt by faculty when research proposals fail to gain approval.

The Working Group recommends that:

- 5) **Faculty members interested in researchable problems who lack research training and expertise form partnerships with other faculty members who have the required training and expertise.**

Time for Research

A frequent complaint among faculty members is that teaching and administrative loads are too heavy to allow time for research. We believe this issue has two sides. Schools which are financially hard-pressed will wish to fully occupy teachers who are employed full-time. If they are not holders of research awards the schools, legitimately in our view, can expect them to carry heavier teaching and administrative responsibilities. Faculty must have some assurance however that if they are successful in obtaining awards they will be given sufficient time free of other obligations in order to carry out their research.

The Working Group recommends that:

- 6) **Administrative policy in each Faculty of Dentistry guarantee sufficient time (up to 50%) free of other obligations for funded investigators to conduct research.**

Sources of Funds

Knowledge of the sources of funds to support research is not adequately appreciated by many faculty members, including faculty well qualified to conduct research. This report shows that there are some forty agencies currently funding dental research (Tables 8 and 9). Faculty should be more energetic in seeking funds from these organizations and more enterprising in exploring the possibilities of additional sources of funds drawing on the descriptive material in the Canadian Directory of Foundations.

Adding New Strength

Although dental schools are hard-pressed financially and are generally pessimistic about the prospects of making new appointments of persons well-qualified for research there are in fact opportunities for adding new strength. Several agencies will provide the salary of scientists brought onto the staff subject to high standards of performance.

MRC has several categories of faculty support, described in Appendix III. They include Scholarships which will pay the salary of newly-appointed researchers of outstanding ability for up to five years. MRC Scientists are more senior investigators with from four to eight years of independent research and a reputation for excellence. Salary awards can cover five years. Research Associates (a new award limited to three per university) have at least nine years independent experience and must be outstanding — only five awards are available each year.

Development grants, available through MRC to designated schools with "less than optimal" research programs, are intended to aid in the recruitment of new faculty members who have the potential to make significant research contributions. They pay for salary, operating funds and equipment. The schools find it difficult to recruit however on the uncertain prospects of obtaining a Development Grant. The Working Group believes that a change in the procedures for reviewing a Development Grant proposal might overcome the obstacle. We visualize two stages to the review process. Applicant schools would be asked to submit a proposal identifying the intended area of concentration, the resources (personnel, space, equipment, etc.) already available which would be committed to the development, the kind and required qualifications of scientific talent which would be recruited, and the school's plans for assimilating the scientist(s) on to the faculty payroll when the Development Grant terminated.

MRC if satisfied with the viability and quality of the proposal would approve it subject to recruitment of scientific staff with the specified qualifications. This procedure would allow a school to recruit properly qualified staff without making an offer to a candidate which had to be conditional on receiving a grant. The Working Group recommends that:

- 7) **MRC be prepared to approve proposals for Development Grants before recruitment of scientific staff subject to receipt of a satisfactory and viable development plan, the approval being conditional on subsequent recruitment of qualified scientific staff as described in the proposal.**

Another avenue of support is a National Institute of Health research grant which allows payment of up to 50% of the salary of a principal investigator.

The National Health Research and Development program offers three categories of award covering most of the recipients' salary. They are a postdoctoral fellowship, National Health Research Scholar, and National Health Scientist, the latter renewable for life. These awards are all limited to the public health or population health fields (See Appendix III.)

Finally for faculty in Alberta a variety of awards, the most senior of which could carry life-time salary support, are available through the Alberta Heritage Foundation for Medical Research; and in the province of Quebec the Fonds de la Recherche en Santé offers salary awards for periods of five years, renewable. The Ontario Ministry of Health offers a Career Scientist Award for five years, renewable. It must be emphasized that all these awards are offered only to candidates who are outstanding.

The Working Group recommends that:

- 8) **Faculties of Dentistry familiarize themselves with awards which can cover the salary of investigators and subject to a carefully designed strategy for research development, actively recruit candidates who can meet the criteria of excellence demanded by the granting agencies.**

The Lack of Clinical Research

A second characteristic of Canadian dental research is the small proportion which is clinical and the small proportion of clinical teachers holding research awards. One of the frequent complaints heard during visits to the dental schools was about failures to gain approval for clinical research. In order to gain some insight about the proportion of MRC awards for basic studies as opposed to clinical studies*, a count was made of grants to dental schools as recorded by MRC in its "Reference List of Health Science Research 1984-5." While this list is incomplete (it does not include awards made in March 1985) it is nevertheless illuminating. A total of 49 awards was identified. Thirty-eight were classified as basic studies and this group included one program grant, one development grant and one group grant, each of which involves several studies. Eleven were classified as clinical studies. Of these only two involved clinical trials.

These figures should be assessed against the size of the potential applicant pool. The full-time clinical staff numbered 277; the basic science total was 105 (Table 3). It can be seen also in Table 4 that in 1979 only 9.2% of DDS full-time faculty held research grants (from any source) whereas 64.9% of full-time Ph.D. faculty held awards. Table 5 illustrates however that, contrary to the perception of some clinical researchers, the success rate for clinical applicants over a period of five years has been comparable to that of non-clinical applicants.

From these data it is clear that most dental research in Canada is non-clinical and the amount of clinical research in relation to the size of the clinical staff is exceedingly small.**

This is a pity for two reasons. The first, alluded to above, is that it reflects a doctrinaire approach to clinical dentistry, a belief that techniques introduced and taught traditionally represent the substance of dental education. The fact is however that relatively few therapeutic procedures or techniques used in clinical dentistry have been subjected to the rigours of good clinical trials. It is true that most of them have stood the test of time and have provided valuable service to patients but that criterion falls short of requiring scientific data from testing and comparing alternative approaches. There is, in short, a rich field of opportunity for important clinical research and clinical trials.

The second reason is that the absence of critical enquiry and a research perspective in clinical teaching means that students are short

*Clinical studies were defined as studies related to clinical diagnosis and/or treatment involving patient management. The designations by the scorer were in some cases arbitrary so the totals should not be considered to be precise. It should be noted also that some titles which represent dental research were awarded to departments or institutions other than dental schools. These were few in number and were not included.

**Some additional clinical research including some clinical trials is carried on under commercial sponsorship. Nineteen grants or contracts from commercial sources were held in 1984-5 (Table 8).

changed. They themselves adopt the posture of their role models and aim only at acquiring the skills to perform the demanding technical tasks of clinical dentistry as well as their teachers. While this goal is important it is not enough for a true professional.

The key to addressing the inadequacy of clinical dental research was identified succinctly in the Report of the Ad hoc Committee of Clinician-Scientists to the Medical Research Council of Canada and the Royal College of Physicians and Surgeons of Canada, 1981: "The major thrusts required to remedy the problem lie, first, in improving our ability to recruit young dentists or dentists in training, into research training; second, in providing research training of the quality available elsewhere in the health sciences; and third, in providing newly-qualified clinician-scientists with the opportunities to do research equivalent to those provided to clinician-scientists elsewhere in the health sciences."

The recommendations which follow are addressed to achieving these three objectives. It is important to understand first the obstacles which have stood in the way of the development of a cadre of qualified clinician-scientists. The Salter Report* describes the difficulties which can be summarized as follows:

- a) Dentistry is a "practical profession" which attracts students who are looking for independence and a career perceived to rely heavily on technical skills.
- b) There are few clinician-scientists in dental schools to provide role models. Research plays virtually no part in the student's clinical instruction and experience.
- c) Graduates, frequently burdened with debt, have the opportunity of entering private practice and gaining prompt financial returns immediately following graduation.
- d) Dental graduates who wish to undertake specialty training must be prepared to finance the training themselves. No residencies except for a few in oral surgery and oral pathology exist to support specialty training.
- e) The time to obtain specialty training plus Ph.D. level training (the minimum suitable for a scientific career) is at least six or seven years and the financial returns of an academic appointment are far less than the earnings from specialty practice.
- f) Heavy teaching and administrative loads for clinical teachers act as a disincentive to engage in research.

*Report of MRC Committee on Clinician-Scientists in Canada, June, 1981, Ottawa.

The Working Group's suggestions for offsetting these obstacles and acquiring a well-trained and active establishment of clinician-scientists are directed at the Medical Research Council and the Faculties of Dentistry.

The Working Group recommends that:

- 9) **The training grant or grants (see recommendation 1) be designed to include training of clinical specialists with Ph.D. level academic qualifications.**

This recommendation is directed at both MRC and the schools. We believe that an important objective of training aimed at filling national needs should be that it offers opportunities for training of both basic scientists and clinician-scientists. We believe the level of training should be the Ph.D. or equivalent. Only persons so trained are likely to be competitive. This is not to suggest that M.Sc. level training is not useful but the limited research experience in a Master's program is unlikely to lead to a serious scientific career in either a basic science or clinical field. We believe the training grant applicant(s) should design the program accordingly and MRC should look for a proposal or proposals which meet the criteria of quality training for both clinicians and basic scientists.

The Report of the MRC Committee on Clinician-Scientists in Canada, 1981 recommended the provision of a special pool of "Half-Scholarships" for clinicians with D.D.S./Ph.D. qualifications to spend a minimum of half their time in research. This would free up half the individual's salary which could be used by the Dean for part-time teachers to assist in clinical teaching. It was proposed that such "half-scholarships" could be held for up to five years as a means of allowing newly qualified faculty to become established. The Working Group endorses this proposal and therefore recommends that:

- 10) **MRC offer Half-scholarships tenable for up to five years for D.D.S./Ph.D. clinicians to spend a minimum of 50% of their time in research.**

A view of clinicians who have applied unsuccessfully for MRC support is that the dental science committee, composed of basic science specialists, is unsuited to review clinical applications. Although the Working Group has no evidence of inappropriate scoring of clinical proposals it does recognize that there are legal, ethical and logistical differences between clinical and laboratory research which require recognition. The use of appropriate referees by the dental sciences committee can deal satisfactorily with many clinical science proposals but some, especially those involving clinical trials, would be more appropriately assigned to the clinical trials committee of MRC. Knowledgeable dental representation on this committee would facilitate expert review. The Working Group recommends, therefore, that:

- 11) **An appropriately qualified person with a degree in dentistry be added to the Clinical Trials Committee.**

Our remaining recommendations on the subject of strengthening clinical research are directed at the dental schools. The most important change required is a change in policy concerning recruitment, and appointments and promotions. Many of the schools have given little more than token attention to academic qualifications and research potential in seeking clinical teachers, preferring to rely on clinical training, experience and skills. It would be invidious to change the ground rules for persons already on staff in mid-career, but it is certainly feasible to define expectations and criteria for promotion differently in engaging new faculty. This is precisely what we recommend, i.e. that:

- 12) **Newly engaged clinical faculty be selected on the basis of demonstrated qualifications of clinical excellence and scientific competence and that for these faculty the criteria for promotion include explicit requirements covering research productivity.**

We referred above to the financial impediments to a career as clinician-scientist. Among them is the fact that students usually have no source of support for the clinical specialty part of their training. Meeting these costs over a period of two or three years during a six to seven year total training period represents a formidable obstacle. The University of Manitoba and the University of Montreal have found a way to meet this challenge. Students obtaining training who are expected to join the faculty may be offered an appointment during their training and be paid a stipend as a faculty member on leave. This policy can provide financial assistance which may make the difference between completing an arduous training program or cutting it short. In addition, at modest risk, the school puts itself in the position of pre-empting the competition in recruiting a new faculty member. We believe that a realistic approach to financial support of academic trainees must include support during the specialty phase of training. The Working Group recommends that:

- 13) **Faculties of Dentistry offer appointments on leave to trainees whom they intend to recruit in order to pay stipends during the period of training for a clinical specialty.**

An option currently being introduced by the University of Toronto which is expected to shorten the time and reduce the cost of training is the combined D.D.S./Ph.D. program. This program which will identify promising students early in their undergraduate education provides for concurrent registration in the graduate school and year-round study. Students so enrolled are eligible to apply for MRC Studentships and can have the stipend pro-rated according to the proportion of time devoted to research. This appears to be an efficient arrangement as well as a recruiting device for academic talent. The Working Group recommends that:

- 14) **Dental schools explore the option of combined D.D.S./Ph.D. programs and introduce such programs when opportunities for training suited to academic dentistry exist.**

Dental School Operating Funds for Research

The total budget of the dental schools in 1984-5 ranged between a low of \$2.5 million and a high of \$10.4 million. Naturally most of the expenditures are for salaries (on average about 88%). The remaining 12% ± covers other expenditures and includes discretionary funds available to the Dean for the support of research. The amounts actually budgeted for this purpose by seven of the schools hovered close to \$25,000. Three of the schools (Toronto, Manitoba and Western) reported budgeted discretionary funds for the support of research of approximately \$100,000 each. The main expenditure for research by each school is, of course, that proportion of salaries which supports research activities but given the need for development it is surprising that only one of the schools with limited research activity (Western) allocates significant general operating funds to this purpose. In the view of the Working Group a level of \$25,000 ± is inadequate to promote research and we urge the Deans to allocate some general operating funds to enlarging the amount substantially beyond the level of the MRC Dean's fund. A sum totalling \$100,000 would represent a commitment no larger than 3% of the budget of the smaller schools and 1% of the larger schools.

We wish to identify three purposes to which such funds could most usefully be directed. The first is to cover the initial year's salary for highly qualified faculty with proven research capability. During this first year application could then be made to an appropriate agency for an award including salary support -- MRC, NIH, NHRDP. Some risk would be involved in recruiting in this way because applications for an award involving salary support might not be successful. If the worst came to the worst and a school was obliged to find the funds to continue the salary, the same source might have to be used through to the completion of an initial three-year term. In any case, the availability of funds which can be used on a rotating basis would greatly facilitate recruitment of faculty with genuine research capability.

The second important use for discretionary funds would be to allow faculty heavily loaded with teaching and administrative duties the purchase of time released for research in the event they are successful in obtaining an operating grant. The dollars would be directed to the employment of part-time replacements to allow the research to proceed. We would see such an arrangement as temporary. If the researcher has continued success a permanent reallocation of his time should be arranged consistent with the principle that funded researchers should have up to 50% of their university time available for research.

The third use of the Dean's fund should recognize the difficulty for new faculty in obtaining an initial grant. A repeated complaint was that beginning faculty who have recently completed training have no "track record" and are accordingly at a disadvantage in competition for limited funds. The Dean's fund could assist researchers to launch a program quickly and produce published results to enhance their prospects of obtaining a grant. We draw attention also to the eligibility of Canadian faculty for the NIH small grants awards of up to \$15,000. Again this source can provide a route to initiating a research program.

If the use of discretionary funds is to be effective in catalyzing

research development the choice of individuals to be supported will be crucial. They must be persons who have good training and a high probability of carrying out independent research successfully. The Deans can be assisted in allocating the funds by seeking the advice of a committee of established researchers. In some schools it would probably be necessary to draw some membership for such a committee from other health science faculties if the dental school does not have enough qualified researchers.

The Working Group recommends that:

- 15) **Each dental school establish a research development fund of \$100,000 using the MRC Dean's fund and general operating grants, to be used on the advice of an Advisory Committee on Research Development as an aid to recruitment and to assist in the initiation of research.**

Perceptions About the Medical Research Council

Across the country the Working Group was exposed to two very different views of the operations of the Medical Research Council. One view, held in general by those who have been successful in obtaining support from the Council is that the Council requires high standards of quality and performance, the peer review committees are tough but fair, the dental science committee assessments are neither more nor less rigorous than those of other committees. Although we heard a few complaints from applicants about proposals which were approved but not funded, there was remarkably little criticism concerning funding levels. Successful applicants are able to conduct their research without serious financial limitations.

The other view, held most often by unsuccessful applicants, is that the system operates as an "old boy" network which is prejudiced against newcomers, against research addressing unfashionable problems, and against clinical research. The dental science committee is perceived to be composed of an unchanging membership of scientists who favour their own fields of interest and is thought by some to apply more rigorous standards than do other peer review committees.

The Working Group's conclusion is that the former view is much closer to the truth than the latter view. The Council does indeed require proposals of scientific merit and seeks evidence that the applicant has the qualifications necessary to undertake the research. These criteria do favour investigators with a good "track record" as illustrated in Table 25 which shows that the chances of success for renewal applications are much better than for new proposals. The Committee nevertheless gives sympathetic attention to new and unknown applicants. The onus must be on the applicant to not only submit a carefully thought out and properly documented proposal but to provide documented evidence that he has the training and ability to carry it out.

We found no convincing evidence that the dental science committee applies any different standards or scoring to the proposals it reviews than other committees. Table 25 shows that the success rate of dental proposals between 1983-5 was lower than the average for all proposals in both new and renewal categories, but the differences are not large and could be accounted for by a combination of chance and real differences in the quality of proposals. In fact if only 10 more dental applications had been approved in the two year period the percentages would have been identical. The scoring and performance of all committees is monitored to ensure uniformity across the wide range of interests of the Council. The membership of Council and its peer review committees is rotated regularly. Committee members themselves must have been successful applicants for research support. Clinical research, especially clinical trials, have been identified by the Council as an important area for development and a number of initiatives have been introduced to facilitate progress, including the establishment of a clinical trials committee. In short, the policies of the Council and the operation of its committees appear to be sound.

The Working Group sees the composition of the dental science committee as well suited for reviewing both basic science proposals and clinical science proposals other than clinical trials. We believe

proposals for clinical trials should be directed to the clinical trials committee and have recommended (above) that properly qualified dental representation should be added to that committee. We draw to the attention of those clinical researchers who expressed lack of confidence in the composition of the dental sciences committee that it is the practice of all MRC committees to draw heavily on the advice of external expert referees in any case where the competence of the committee members to deal with a particular proposal is in doubt.

The Working Group is concerned about the frequency of misconceptions and misinformation about the policies and operation of the Medical Research Council. We suspect that such misconceptions may be held just as widely in other components of the health sciences community. We recommend that:

- 16) **MRC review its arrangements for communicating with the health sciences community to ensure that its policies and procedures are widely understood.**

A further aspect of Council's communications is the communication to applicants of the decision concerning support. These communications include the reports by external reviewers but no summary of the discussion by the review committee which lead to the decision. On occasion the views of the external reviewers may be inconsistent with the decision of the committee and this leaves applicants confused and frustrated. We believe the "pink sheets" used by NIH to communicate the basis of its committees' judgements are useful and provide applicants with an understanding of the reasons for a decision -- which of course may or may not satisfy them. In any case good communication is an asset and the Working Group recommends that:

- 17) **MRC develop a system of communicating to applicants the basis of peer committees' judgements.**

Community Dental Health Research

A great need exists to examine critically a whole series of issues related to the prevalence and severity of dental disease, the effectiveness and efficiency of preventive and therapeutic interventions and the monitoring and evaluation of existing and new dental health programs. A McMaster group has described the needs (in the wider context of community health) in a model labelled the Measurement Iterative Loop.* Briefly the steps involved are:

- a) Measurement of the burden of illness. Data on dental status of adults, the elderly and special groups including native people are lacking.
- b) Determination of the etiology of dental disease. From a community health perspective this involves a focus on risk factors, especially those amenable to preventive interventions.
- c) Assessment of effectiveness of existing or new programs -- especially in community settings.
- d) Efficiency, i.e. costs, and particularly relative costs.
- e) Synthesis and implementation of new programs, based on the outcome of earlier steps.
- f) Monitoring of progress of new programs.
- g) Reassessment of the burden of illness.

Systematic community dental health research programs are virtually non-existent in Canada though the results of such studies will be of importance to government and are certainly consistent with the priorities of the National Health Research Development Program.

In a position paper published in the Canadian Public Health Association Health Digest, 1980, recommendations were made to assist the Department of Health and Welfare to:

- a) Develop a stable policy for research of community health programs.
- b) Ensure research for community health is of high quality with the best research being funded and with a dominant national program based on peer adjudicated review.
- c) Establish a clear national policy and priorities for community health program research that takes into account the needs of Canada, including regional needs, and the opportunities for innovative research.

Tugwell, P. and Bennett K.J. in "Proceedings of the Conference on Health in the 80s and 90s". Council of Ontario Universities, Toronto, pp. 45-63, March 14-17, 1982.

- d) Make the Federal government the dominant body funding research for community health programs in Canada in order to provide much needed national leadership.*

The current role of NHRDP suggests that attention has been given to priorities and to the quality of research. However, it cannot be said that a stable policy and national dominance have been achieved insofar as community dental health research is concerned. The 1984-5 total support from NHRDP for research, training and conferences was only \$215,807. The average over the past five years was \$273,000 (Table 23).

The total budget of NHRDP for research, demonstration projects and personnel in 1984-5 was approximately \$18 million. The share allocated to dental applications was exceedingly small -- only about 1% of the total. The total budget has been growing while the allocation to dental problems has been shrinking over the past five years (Table 26).

In the view of the Working Group the NHRDP funding level is too small to mount a stable properly funded systematic program of community dental health research. However, the factors accounting for the very small allocations are not clear. The Department of Health and Welfare was unable to provide data on the number of dental applications or the proportion of applicants who were funded. It may be that the success rates for dental applications have been low, reflecting on either or both the quality of the proposals and/or the priority they received either federally or provincially. In the absence of data we are unable to draw a conclusion.

One factor which we believe to have had a dampening effect on potential applicants has been their perception that NHRDP establishes rapidly changing short term priorities which tend to be narrowly focussed. Researchers expressed frustration with the difficulties of trying to aim at a moving target. It is the view of the Working Group that NHRDP should rely on generic priorities such as those described on pages 41 and 42, and should avoid modifying them, elaborating on them, or supplementing them with specific priorities in ways which can interfere with the stability of the program.

It does seem likely that the number of applications itself is small, reflecting in part the inadequate size of the pool of researchers with good expertise in community dental health research. A review of the Canadian Dental Faculty and Staff Register 1984-5 shows a total of 29 full-time faculty listed under dental public health, community dentistry, epidemiology or biostatistics. Only three appear to have Ph.D. or equivalent qualifications. Eleven hold a Master's degree, and 10 have no formal advanced qualifications. While some of the faculty with DDPH and/or Master's qualifications are experienced researchers, it is evident that the total number of qualified community dental health researchers is very small. The Working Group concludes that the deficiencies in community dental health research reflect shortages of trained investigators and perhaps also an inadequate support system under the NHRDP. We recommend that:

*CPHA Position Paper: "Research funds for community health programs in Canada". CPHA Health Digest, 4:249-50:1980

- 18) NHRDP funding for dental research be increased subject to receipt of high quality proposals and the Program rely on the judgement of peer review committees in determining the relevance of the proposal to national and provincial dental health priorities.
- 19) Because of the unique problems in community dental health research NHRDP establish a peer review committee for dental health research.
- 20) NHRDP invite proposals for a training grant to develop dental epidemiologists competent to conduct community dental health research and NHRDP be prepared to fund one such proposal capable of graduating up to three Ph.D. level researchers each year for the next several years.
- 21) The community dental health researchers in Canada cooperate to develop a systematic national program of community dental health research designed to elucidate the prevalence and severity of dental disease and the effectiveness and efficiency of preventive and therapeutic interventions and to monitor and evaluate existing and new dental health programs.
- 22) NHRDP sponsor a national symposium of community dental health researchers to facilitate the development of a systematic national program of community dental health research.

Space for Research

During the course of its visits, the Working Group made enquiries about the adequacy of space to accommodate research activities. In addition we obtained data from the Deans identifying the number of square feet in the dental school assigned for research purposes. The areas available varied from as little as 3,250 square feet to as much as 27,711 square feet (Table 27). Although we heard some complaints about crowding in several of the schools the issue was pervasive in two, namely UBC and Western. In an effort to obtain some measure of the adequacy of space relative to intensity of research effort we examined the number of square feet available per \$1,000 of reported research grants and these figures are also shown in Table 27. They show that UBC (whose complaints were the most vociferous) occupies only 4.6 square feet per \$1,000 of research support -- the smallest amount of space (relatively) in the country. Although the shortage at Western was also reported to be severe, the 15.9 square feet of space per \$1,000 of research funds was not the second lowest ratio. In fact it was higher than the ratio in the two schools with the largest amounts of research funding -- University of Toronto and University of Alberta, and these institutions reported no concerns about space. The explanation is that most of the available space at Western has been occupied for some years by dental materials laboratories which house considerable heavy equipment. Little remains for researchers in other disciplines. Thus the figure of 15.9 square feet per \$1,000 of research grants shown for the University of Western Ontario is misleading.

Our general conclusion is that space allocation of about 10 square feet per \$1,000 in research grants is adequate and lack of space does not represent a significant problem except in two schools -- UBC and Western.

The shortage of research space at UBC is quickly apparent from a walk through the facilities. The laboratories are overcrowded with equipment and apparatus. The number of persons occupying the available space (scientists, technicians and students) is too great for reasonable efficiency and may in fact constitute a safety hazard.

The problem at Western is different. Most of the modest space available has been assigned to dental materials. The school is attempting to expand its research but is facing real difficulty in placing new faculty in space appropriate for their research.

The Working Group recommends that:

- 23) **The university administrations at UBC and the University of Western Ontario in establishing space priorities recognize the need for additional space for dental research.**

Indirect Costs

During a number of visits members of the Working Group heard concerns expressed about the impact of indirect costs. Most universities are attempting to cope with shrinking financial resources relative to their teaching obligations. Administration in schools with substantial research activity continue to find their financial problems aggravated by the necessity of diverting what they see as teaching dollars to the coverage of indirect costs of research. Accordingly they argue for the need to introduce policies for the payment by federal granting agencies of the indirect costs of the research which they fund. This position, of course, is not universally supported. Many funded researchers argued that the net result of a policy designed to meet indirect costs would be reduction in funds available for the support of direct costs.

The Working Group recognizes that the problems associated with indirect costs are by no means unique to dental schools and that there is no case for special treatment of dental research. Nevertheless, the issue of indirect costs continues to be a problem for universities which remains unresolved though much has been written on the subject. While addressing it appears to be beyond the terms of reference of the Working Group we express the view that it is an issue which deserves attention at the highest policy level of the Government in Canada.

SUMMARY OF RECOMMENDATIONS

The Working Group recommends that:

- 1) MRC entertain a proposal or proposals from Faculties of Dentistry for the establishment of a training grant or grants which in toto meet the anticipated Canadian demand for dental researchers, estimated at 13 persons annually.
- 2) The number of summer studentships available to dental schools be increased by 30 and that the additional 30 studentships be awarded through a national competition which takes account of the qualifications of both the student and his/her sponsor.
- 3a) Some reasonable share of the funding of basic science departments be derived from the budget of the dental schools and the dental schools participate appropriately in the selection of basic science appointees.
- 3b) Alternatively a written agreement be negotiated between the Faculty of Dentistry and the Faculty of Medicine spelling out the responsibility of basic science departments for the conduct of research relevant to dental problems.
- 4) All dental schools draw on the resources of clinicians and basic science teachers to introduce research seminars and undergraduate thesis programs and to expand the number of summer studentships, all as a means of stimulating interest in dental research and a more scholarly approach to dental education.
- 5) Faculty members interested in researchable problems who lack research training and expertise form partnerships with other faculty members who have the required training and expertise.
- 6) Administrative policy in each Faculty of Dentistry guarantee sufficient time (up to 50%) free of other obligations for funded investigators to conduct research.
- 7) MRC be prepared to approve proposals for Development Grants before recruitment of scientific staff subject to receipt of a satisfactory and viable development plan, the approval being conditional on subsequent recruitment of qualified scientific staff as described in the proposal.
- 8) Faculties of Dentistry familiarize themselves with

awards which can cover the salary of investigators and actively recruit candidates who can meet the criteria of excellence demanded by the granting agencies.

- 9) The training grant or grants (see recommendation 1) be designed to include training of clinical specialists with Ph.D. level academic qualifications.
- 10) MRC offer half-scholarships tenable for up to five years for D.D.S./Ph.D. clinicians to spend a minimum of 50% of their time in research.
- 11) An appropriately qualified person with a degree in dentistry be added to the Clinical Trials Committee.
- 12) Newly engaged clinical faculty be selected on the basis of demonstrated qualifications of clinical excellence and scientific competence and that for these faculty the criteria for promotion include explicit requirements covering research productivity.
- 13) Faculties of Dentistry offer appointments on leave to trainees whom they intend to recruit in order to pay stipends during the period of training for a clinical specialty.
- 14) Dental schools explore the option of combined D.D.S./Ph.D. programs and introduce such programs when opportunities for training suited to academic dentistry exist.
- 15) Each dental school establish a research development fund of \$100,000 using the MRC Dean's fund and general operating grants, to be used on the advice of an Advisory Committee on Research Development as an aid to recruitment and to assist in the initiation of research.
- 16) MRC review its arrangements for communicating with the health sciences community to ensure that its policies and procedures are widely understood.
- 17) MRC develop a system of communicating to applicants the basis of peer committees' judgements.
- 18) NHRDP funding be increased subject to receipt of high quality proposals and the Program rely on the judgement of peer review committees in determining the relevance of the proposal to national and provincial dental health priorities.

- 19) Because of the unique problems in community dental health research NHRDP establish a peer review committee for dental health research.
- 20) NHRDP invite proposals for a training grant to develop dental epidemiologists competent to conduct community dental health research and NHRDP be prepared to fund one such proposal capable of graduating up to three Ph.D. level researchers each year for the next several years.
- 21) The community dental health researchers in Canada cooperate to develop a systematic national program of dental health research designed to elucidate the prevalence and severity of dental disease and the effectiveness and efficiency of preventive and therapeutic interventions and to monitor and evaluate existing and new dental health programs.
- 22) NHRDP sponsor a national symposium of community dental health researchers to facilitate the development of a systematic national program of community dental health research.
- 23) The university administrations at UBC and the University of Western Ontario in establishing space priorities recognize the need for additional space for dental research.

APPENDIX I

LIST OF AREA CHAIRMEN FOR SELECTION OF MOST IMPORTANT
PAPERS BY CANADIAN DENTAL RESEARCHERS

Connective Tissue Biology	Dr. Richard Ten Cate University of Toronto
Dental Materials	Dr. Derek Jones Dalhousie University
Epidemiology and Community Health	Dr. Donald Lewis University of Toronto
Growth and Development	Dr. Arto Demirjian University of Montreal
Microbiology	Dr. Barry McBride University of British Columbia
Neurosciences	Dr. Barry Sessle University of Toronto

APPENDIX II

LIST OF EXTERNAL REFEREES CHOSEN TO REVIEW SELECTED
PUBLICATIONS BY CANADIAN DENTAL RESEARCHERS

Connective Tissue Biology:

J. D. Termine	NIH
H. C. Slavkin	University of Southern California
A. Veis	Northwestern University
R. C. Page	University of Washington

Dental Materials:

D. B. Mahler	Oregon Health Sciences University
R. G. Craig	University of Michigan
J. Nicholls	University of Washington
M. D. Jendresen	University of California, San Francisco

Epidemiology and Community Health:

B. Burt	University of Michigan
C. Douglas	Harvard

Growth and Development:

D. Enlow	Case Western Reserve University
M. C. Johnston	University of North Carolina
B. Solow	The Royal Dental College Copenhagen, Copenhagen, Denmark
B. Prahll-Anderson	Free University, Hilversum, The Netherlands

Microbiology:

J. Carlsson	University of Umea, Umea, Sweden
H. van der Hoeven	University of Nijmegen, Nijmegen, The Netherlands
J. Cisar	NIH
W. Loesche	University of Michigan

Neurophysiology:

Dubner	NIH
Goldberg	UCLA
Mathews	Bristol University
Kawamura	Osaka University Dental School

APPENDIX III

POLICIES OF FUNDING AGENCIES

MEDICAL RESEARCH COUNCIL GRANTS AND AWARDSA. RESEARCH FUNDING PROGRAMS1. Grants Program

Operating Grants

Funds awarded in this category may be requested for direct research costs (e.g. supplies, minor equipment), employment of research assistants, technicians, trainees, summer students and travel.

Major Equipment Grants

These grants are made to support requests for the purchase of single items of research equipment of more than \$15,000 or for several items totalling more than \$15,000.

Maintenance Grants

These grants support the maintenance of facilities shared by groups of researchers (e.g. electron microscope costs).

2. Collaborative Research Programs

MRC Groups

These awards will support the salaries of an administrative leader (Director), several established investigators (Members) and independent investigators (Associate Members) all of whom will be working on projects integrated towards common objectives. All are expected to devote their total research endeavours to the Group. Core support includes the direct research costs, plus major equipment and maintenance costs and support for research assistants, technicians and trainees.

Program Grants

These awards will support teams of at least three researchers who may bring a multidisciplinary approach to focus on a research program. While certain facilities may be shared, this collaboration need not require their exclusive commitment of time or effort. Investigators may even be in different geographic locations. Core support is similar to that of Groups.

Clinical Trials

These include trials assessing the efficacy of diagnostic and therapeutic procedures and are submitted through the Operating Grants system.

3. Development Programs

Development Grants

These are designed to aid in the recruitment of new faculty members who have the potential for major accomplishments in research. Only faculties designated by Council as eligible can apply. Eligible schools are those who have been identified where the research program is less than optimal to support professional education and health care. Category 1 includes support for investigator's salary, operating funds for three years, and major equipment costs. These awardees must spend 75% of their time on research. Category 2 supports the salaries of Visiting Professors for up to one year, \$15,000 operating funds and travel support (including family).

Subject Research Development Grant

This program presently supports only one subject: perinatology. However, dental faculty members are eligible. Grants are for five year periods and are not renewable. Funds will be provided for direct costs, research assistant, technician and trainee support, major equipment, and even investigator salary although this will then commit 75% of their time to research.

Biotechnology Development Programs

Biotechnology Development Grants: These awards will assist in the recruitment of new faculty members to develop research in the application of biotechnology to problems directly related to the health sciences. These awards include investigator salary for up to five years and operating grants for three years.

Biotechnology Training Centre Awards: These awards are designed to support the training of at least two individuals in centres where scientists are applying biotechnology in the disciplines of health sciences. Graduate students must be Canadian. A research allowance of \$2,000-\$5,000 is included.

Biotechnology Retraining Awards: This will provide salary for established investigators to spend a year at another laboratory to enhance their own research by the application of biotechnology. Should the investigator's university already supply salary support, support will be provided for replacement faculty during the investigator's absence.

4. Special Programs

Medical Education and History of Health Sciences

Special Projects

Council will consider projects which do not fall in the above categories before the application should be prepared formally.

B. RESEARCH PERSONNEL PROGRAMS

1. Research Trainee Programs

Undergraduate Research Scholarships: These are for undergraduate medical, dental and pharmacy students in Canadian Schools for three months salary (\$3,150-\$4,410).

Studentships: These awards support students enrolled in M.Sc. (2 years) or Ph.D. (up to 5 years) programs in Canadian universities. Students in combined M.D./Ph.D. or D.D.S./Ph.D. programs will have their stipends prorated according to the time devoted to research (2/3 minimum). This includes a travel allowance for one scientific meeting in Canada per year of tenure.

Fellowships: These awards support trainees who already hold a professional degree (e.g. D.D.S.). Enrolment in a graduate program is not necessary. These awards are primarily available to only Canadians and usually can be held at Canadian schools only. Stipends (\$22,050-\$34,650) are renewable for a total of up to five years. Fellows are not allowed to receive any unrelated remuneration. A research allowance of \$1,300 can be used to defray research expenses or travel costs.

Dental Fellowships: This award (evolved from the Dental Training Grant Program formerly at the University of Toronto only) will support those with a D.D.S. training towards a Ph.D. (but not necessarily). Candidates must be Canadian citizens or permanent residents. They must be proposing to do specialty certification or have already done so. The sponsoring university must indicate that the candidate has potential for a future academic appointment. The Fellowship may be held in Canada or abroad or even in more than one location. Support can be renewed up to five years and is at the same level as the Fellowship awards with the same research allowance.

Centennial Fellowships: This will support highly qualified candidates training particularly for independent work in clinical or interdisciplinary research. Candidates must have a professional degree plus four years of academic experience including at least one year of experience in the proposed field of study and propose a program leading to a Ph.D. Candidates already holding a Ph.D. need two years of postdoctoral experience. Candidates may hold these awards in Canada or abroad but preferably at a different institution than where they received their doctorate. Stipends (\$30,450-\$36,225) will be for three years and a research allowance of \$3,350 is included.

2. Independent Investigators Salary Support Programs

Scholarships: These awards are for new faculty members (less than 24 months) to support salary for up to five years in order that they may devote at least 75% of their time to research. Candidates must hold a professional degree or Ph.D. The award is tenable in Canadian schools only. An operating grant of \$15,000 will be provided in the first year, after which the candidate will be expected to compete for operating grants.

Research Associates: This award will aid the recruitment of

outstanding investigators to complement and further develop existing research strengths. Candidates must hold a professional degree or a Ph.D. and have at least nine years experience as an independent investigator. Only five awards are available each year. Salary support is provided at 100% for four years followed at 50% of the approved rate for two years.

3. Visiting Investigators Programs

Visiting Professorships: Each dental school may request support (travel, accommodation, meal and honorarium expenses) for one Visiting Professor from another Canadian dental school. This is intended to foster collaboration and exchange of expertise for each fiscal year. In addition, five special awards are available for dental schools to bring Visiting Professorships from outside Canada. The award maximum is \$1,250 with any additional costs becoming the responsibility of the host university.

Visiting Scientists: These are intended to support investigators from abroad to engage in research at a Canadian university or allow Canadian investigators to work in another laboratory in Canada or abroad. Support for Canadian investigators includes travel allowance only plus up to \$5,000 which can be used from the investigator's current operation grant. Travel allowance for family members is also available for visits of more than six months. Investigators from abroad will also receive salary support for up to 24 months plus an operating grant of up to \$5,000 if no other sources are available.

France-Canada Exchanges: Three programs (MRC-INSERM; Intergovernmental Agreement; MRC-CNRS Agreement) provide for bilateral exchanges and include travel (families included if greater than six months visit) and living allowances.

C. OTHER PROGRAMS

Travel Grants: These are available for short visits (maximum 30 days) to specific laboratories to further their research.

Support for Workshops and Symposia: Workshops of 10-30 persons meeting to address specific problems with the intention of reaching a consensus on conclusions or recommendations are eligible for travel and subsistence support of participants and for the costs of administering the workshop. Council will consider support for symposia which are held in Canada in conjunction with Canadian national scientific society meetings, relate to a subject of significance to Canadian investigators, and are open without fee to all health science students.

D. SPECIAL RESPONSIBILITIES

US NIH International Research Fellowships: The MRC serves as a screening mechanism for the Canadian candidates (five or six per year). These awards are for one year at any US institution. These are intended for promising young investigators who are not proposing to pursue a training or teaching or clinical treatment program while in the US. Candidates must have a professional degree or Ph.D., Canadian citizenship

and sponsored by a school indicating their potential for an academic appointment. Support includes salary at the Fellowship level plus travel allowance. The host institution allowance will provide for operating funds and any travel to meetings.

NATIONAL HEALTH RESEARCH AND DEVELOPMENT PROGRAM

Eligibility

Any Canadian institution or government body capable of undertaking the research.

Programs

1. Research Projects

Original investigations undertaken on a systematic basis to test specific hypotheses.

2. Studies

Collection and/or analysis of data to elucidate factors which give rise to the occurrence of phenomena and/or to explore causal relationships.

3. Preliminary Development Projects

The development and evaluation of prototypes of new devices, equipment, systems and procedures relevant to health or health care on a national scale.

4. Demonstration Projects

Projects which involve the implementation and evaluation of innovations in the organization of health delivery services. Funding is limited to three years.

5. Formulation Funding

Financial assistance for applicants who lack ready access to technical assistance and advice and library resources, in order to develop feasible research protocols.

6. Conferences and Workshops

Contributions to cover a reasonable part of costs will be considered for Canadian sponsored meetings in Canada which deal with matters of interest to the Department of Health and Welfare.

Support

Only direct research costs will be supported (e.g. salaries for technicians, trainees, and non-professional assistants, supplies, and equipment).

Selection Process

Applications are first reviewed by the Department of National Health and Welfare for relevance and then reviewed by the province of origin for their appraisal of provincial relevance. External reviews and an internal review committee then determine scientific merit. Applicants may be asked to modify their protocol. An on-site visit may be necessary. Feedback consists of copies of all reviewers comments. The Extramural Research Programs Directorate may also provide suggestions to unsuccessful applicants and encourage modified resubmission. Applicants may contact the Directorate for further information after the results of the competition are announced.

Training Awards

These Fellowship awards are for Canadian citizens registered for an M.Sc. or Ph.D. degree preferably in a Canadian university. Students must be training in research in public health or health delivery. N.B. Students enrolled in professional programs such as D.D.S. or non-research programs such as a Diploma in Public Health or Masters in Public Health are not eligible. M.Sc. support is for two years and the Ph.D. support is for four years (\$11,840-\$18,840) plus a relocation allowance and an annual composite allowance for research and travel (\$1,600-\$2,000).

Career Awards

These awards are for Canadian citizens only who intend to pursue research in public health or health care only. There are four types of awards: Postdoctoral Fellow, Research Scholar, Scientist Award and Visiting Scientist Award.

Postdoctoral Fellow: Candidates must have a professional degree and a minimum of a M.Sc. degree. Support is for two years.

National Health Research Scholar: This award is meant to support promising investigators with proven research experience. Candidates must have the same qualifications as the Postdoctoral Fellows plus two years of postdoctoral experience. Stipends may not completely cover salary support at the candidates institutional level. A small travel and general research allowance (\$6,000 first year, \$3,000 each subsequent year) is also provided. The term of support is for five years and a second award may be applied for another five years.

National Health Scientists Award: This award is meant to support acknowledged leaders in population-health research to facilitate full-time research. Candidates must have at least seven years of research experience. Again, the University may have to supplement the stipend. There is the same travel and general research allowance available. The term of support is for five years and is renewable for life.

NATURAL SCIENCES AND ENGINEERING RESEARCH COUNCIL

Available Awards

Operating Grants: These encompass original research of interest to the individual investigator. Average awards are about \$15,000 with \$50,000 being unusually high. New grantees usually receive a one year award which is almost automatically renewable twice.

Equipment Grants: For equipment over \$7,000.

Travel Grants: To attend meetings, visit other laboratories, invite visitors.

General Grants: Direct grants to Universities.

University Research Fellowships: This provides partial salary support (currently \$28,000) for five years for new faculty members. These individuals normally would have a Ph.D. plus several years of post-doctoral experience. An additional five years of support is available on a declining proportion with the university share increasing each year. Applicants must be Canadian citizens.

Review Process

Applications are reviewed by appropriate peer group committees in addition to external referee reports and are often followed by a site visit. Unlike MRC, NSERC has budgets earmarked for each of the discipline areas (e.g. certain funds are set aside for Experimental Physics applications).

NATIONAL INSTITUTE OF DENTAL RESEARCH (USA)

Canadian researchers are eligible only for Individual Project Grants (ROI) and the Small Grants program both of which are comparable to the MRC Operating Grant.

Awards

Research Project (ROI)

This is identical to the MRC Operating Grant. There is no support for indirect costs or renovation costs for Canadian applicants. The salary of the principal investigator may be supported up to 50%.

Small Grants Program

This is for pilot investigations of one year duration (non-renewable) for a maximum of \$15,000.

Review Process

The Division of Research Grants of the NIH first assigns the

application to NIDR which assigns it to the Oral Biology and Medicine Study Section to review it. At this level the scientific merit and budget are determined. A summary statement is then sent to the Advisory Council which evaluate the application in reference to relevance and priorities. This step can drastically affect an application's outcome. A "pink sheet" feedback summary is sent to each applicant to provide details pertaining to the final decision.

The Small Grants applications are reviewed by a special committee.

In all cases, Canadian applicants compete with their United States colleagues without any penalty or discrimination.

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